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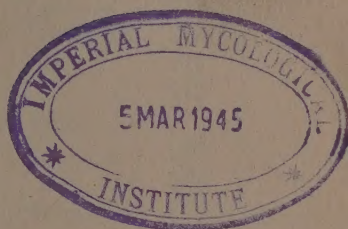
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POTATOES



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POTATOES

The research program with potatoes continues along much the same lines as in former years. The various studies in progress are revised and new studies are initiated as current needs indicate these to be desirable and as finances warrant. The total production of potatoes and the yield per acre for the 1943 season in Maine were both all-time highs. These attest to at least a reasonably well informed industry and, also, to natural conditions highly favorable for potato production. They attest also to the zeal of the potato growers in their efforts to meet the requirements for food production. The progress in research made during the past year is indicated in the following reports.

POTATO DISEASES AND INSECTS

The three most serious potato diseases continue to be bacterial ring rot, late blight, and leafroll including net necrosis. Other disease problems receive considerable attention but the major emphasis is placed on the three just mentioned.

BACTERIAL RING ROT.¹ Some progress has been made toward obtaining a variety resistant to the ring-rot disease. Until such a variety is available, however, the use of control measures involving seed treatment, seed plots, etc., will be necessary.

Better Seed Program. Reiner Bonde, Donald Merriam. During the spring of 1943 a "better seed program" was initiated for the purpose of eliminating ring rot from the potatoes being grown in Maine.

An area was chosen in which to start the cleanup campaign. The farmers of this area were first contacted by the Farm Bureau for the purpose of determining whether their seed stocks were free of the disease. The individual farmers indicated whether ring rot was present in the seed stocks they intended to plant during the following season. In addition to this, bins of potatoes intended for seedstocks were examined for the disease. Farmers were encouraged to send to the Station for examination any seed potatoes

¹ A substantial sum from the cent-a-barrel potato tax has been available for the studies on "Potato Diseases and Insects" and for the studies with "Potato Products."

they found which appeared at all suspicious of having ring rot. An attempt was then made to secure disease-free seed for every grower in the area whose stock was known to be infected.

A survey was made during the harvesting season of 1943 to obtain an estimate on progress made in reducing the amount of ring rot in the selected area as a result of the better seed program. The survey was not as extensive as one conducted in 1941, because it was impossible to secure the necessary trained help to conduct the study while the crop was being dug. However, enough farms and fields were critically examined to show approximately the condition of the potato crop in the area regarding the prevalence of ring rot.

The data secured show that some progress has been made in combating the disease in the area. There was less ring rot in the fields in 1943 than was there in 1941. Some farmers have been able to maintain the same seed stocks free of the disease throughout the entire period since 1937 when the disease was first found in this area. It was learned also that quite a number of growers had eliminated the disease from their farms. Only a few seed stocks which were healthy in 1941 had become contaminated when they were examined again in 1943.

The severity of infection has been greatly reduced in the area since 1941. Most of the infected seed stocks now have the disease in trace amounts only. One badly infected lot, with 25 per cent infected tubers, was found in 1943. This progress was made in spite of the great handicaps which existed during the 1943 season. Growers increased the crop acreage as much as was possible and every available piece of land was planted to potatoes. There was not enough good seed available to plant the increased acreage and many fields were planted with seed stocks known to have the ring-rot disease. It is believed that if the normal size of crop had been planted in 1943 the amount of ring rot would have been even less.

Disinfectants for Killing the Ring-Rot Organism. Reiner Bonde, Donald Merriam. An experiment was conducted in 1943 to determine further the relative effectiveness of certain disinfectants in killing the ring-rot organism on potato sacks or on the equipment used for handling potatoes.

Pieces of burlap sacks were severely contaminated with the ring-rot organism taken directly from diseased potato tubers. The contaminated sacks were soaked for 5-minute periods in the differ-

ent disinfecting solutions and then used in an attempt to infect freshly cut potato seed pieces. The seed pieces which had been inoculated with the pieces of burlap bags were planted in the field.

The results confirm previously secured data that the corrosive sublimate solutions as commonly used for treating potatoes are very effective in destroying the ring-rot organism. Table 1.² Lysol, a coal tar disinfectant, likewise was very effective and no diseased plants resulted from the inoculations made using the pieces of sack treated with this material. Solutions of copper sulfate and formaldehyde greatly reduced the amount of infection but failed to destroy all of the ring-rot organisms. Freshly prepared chlorinated lime and calcium hypochlorite when prepared as directed on the package and used for a 5-minute dip treatment was fairly effective in destroying the infection on burlap sacks.

Nitrogen Trichloride Gas for Control of Ring Rot.³ Reiner Bonde, H. K. Parker. Nitrogen trichloride gas (NCl_3) was tested for its effectiveness as a disinfectant for potato bins and seed stocks. This gas did not destroy the ring-rot organism on potato seed pieces even when used at high concentrations (15 mg. gas per cubic foot) for periods up to four hours. Subjecting seed pieces contaminated with the ring-rot organism to the gas treatment did not materially reduce the percentage of the disease that occurred.

Resistance to Ring Rot in Varieties and Progenies.⁴ Reiner Bonde, Stanislas Snieszko. Previous studies have shown that a few potato varieties and seedlings are resistant to ring-rot infection. Certain crosses also were made and the progenies tested for resistance.

A study was conducted in 1943 to make certain that the absence of the disease in certain varieties in 1942 was not merely due to the inoculated plants having escaped the infection. The Green Mountain, Irish Cobbler, Houma, and Chippewa varieties are

² All Tables are in the Appendix, pages 266 to 297.

³ The gas used for these experiments was generated by equipment loaned by the Wallace & Tiernan Co., Inc., Newark, New Jersey. Dr. H. K. Parker, representing this company, conducted these gas treatments. Grateful acknowledgment is made to him and the Wallace & Tiernan Co., Inc.

⁴ The potato breeding program is cooperative with the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture. Grateful acknowledgment is made to Doctor H. A. Jones, Doctor F. J. Stevenson, and Robert Akeley who are the Bureau representatives on this study in Maine.

highly susceptible and the variety President and the seedlings #46952, #0.55, and #47102 are highly resistant. During 1943, eight varieties were tested regarding their relative susceptibility to ring-rot infection. The data confirm the results of 1942 that the Green Mountain and Houma varieties are very susceptible to ring-rot infection. Table 2. The Katahdin variety is somewhat less susceptible to the disease than is Green Mountain. However, under field conditions the Katahdin is often found to have the disease. This might be due to the fact that the Katahdin variety is relatively resistant to the virus diseases and, therefore, is grown for longer periods of time by farmers before the seed stock is changed, allowing more time in which the ring-rot disease is permitted to build up. The Sebago variety possesses some resistance to ring-rot infection, a fact which seems to be borne out in results obtained by farmers. Surveys conducted in Maine indicate that the Sebago seed stocks are relatively free of ring rot. The President variety, as well as S. 47102, apparently did not contract ring rot in the experiments conducted in 1942 and 1943. However, other studies in which inoculated plants were examined with the aid of the microscope, have shown that the President variety as well as some other resistant varieties may become infected but the symptoms are not very obvious.

The seedling varieties S. 46952 and S. 0.55 developed only 3 and 4 per cent ring-rot diseased plants, respectively, as a result of the inoculations that were made.

Ring-Rot Resistance in Progenies from Crosses with Resistant Varieties. Reiner Bonde, Stanislas Snieszko. Progenies resulting from crossing certain resistant and susceptible varieties were tested regarding their susceptibility to the disease in 1942 and 1943. The data for 1942 showed that the variety President or Seedlings 336-144 and 336-18 when used for making crosses will give a high percentage of resistant seedlings. The results obtained in 1943 have been summarized in Table 3. About 75 per cent of the seedlings are resistant when 336-144 is selfed, or when this seedling is crossed with its resistant parent President. About 40 per cent to 45 per cent are resistant when 336-144 is used as one parent in making the cross. The resistance of S. 46952 can be transmitted to its progeny. This variety, when used as a parent, has the advantage that the seedlings produced are earlier maturing and have a better tuber shape than when either President or its

seedling progeny 336-144 is used in making the crosses. A lower per cent of the seedlings possess ring-rot resistance from the S. 42952 cross than when President or its seedling 336-144 is used as the parent. The ring-rot resistance of Friso also is inherited and 48.6 per cent of the progeny, resulting when this variety was used as a parent, failed to become infected as a result of the experiments conducted in 1943. During 1942 a number of miscellaneous seedlings were tested for resistance to ring rot by inoculating them in the field by the usual seed piece rubbing method. The susceptible seedlings were discarded in 1942 and those that appeared to be resistant were tested again in 1943. Table 4. All of the seedlings selected as being resistant to ring rot in 1942 continued to be resistant in 1943. It is of interest that all of these resistant seedlings had 336-144 as a parent. It is unfortunate that the variety President or its seedling 336-144 gives progenies that are late maturing and with rather poor tuber shape.

Potato Juice in Media as Index of Resistance to Ring Rot.

Stanislas Snieszko, Reiner Bonde. Preliminary experiments indicate that the juice of mature tubers or of stems and leaves when incorporated in laboratory media may provide an index of resistance to the ring-rot disease organism (*Corynebacterium sepedonicum*). The filtrates from the varieties Katahdin, Green Mountain, and President supported abundant growth of the bacterium. Filtrates from seedling varieties believed to be entirely or partially resistant to ring rot supported poor growth. Two seedling varieties supported little or scant growth. The results while not wholly consistent warrant further tests. If some such method can be developed it would be possible to test much larger numbers of seedlings and thus hasten the plant breeding operations.

The Ring-Rot Organism under Different Conditions. Reiner Bonde, Stanislas Snieszko. The ring-rot organism may remain viable for rather long periods under certain conditions. There is evidence, however, that the organism sometimes dies quite fast or soon becomes unable to cause infection. It apparently is unable to survive the winter in the soil under field conditions or in completely decayed potato tissue. In certain experiments the organism did not survive on pieces of burlap sacks which remained wet and on which molds developed. In contrast it remained capable of causing infection for at least 90 days on similar sacks which were relatively dry and on which no molds had developed.

Additional information was obtained in 1943 regarding the length of time the ring-rot organism may remain viable under different conditions. Pieces of burlap and cotton potato bags were contaminated with the ring-rot organism from infected potato tubers or with the organism grown on agar media. Pieces of the contaminated sacks were put into test tubes which were plugged and then stored at different temperatures and conditions. One set was stored exposed to the weather on the north side of a farm building at Presque Isle. Others were stored in controlled temperature lockers at temperatures ranging from 30 to 70° F. and with a relative humidity of 76 to 80 per cent. Pieces of the bags were removed after being in storage 103 and 200 days and tested for their ability to contaminate potato seed pieces and produce the ring-rot disease. The pieces of bags were moistened with water and used to rub the freshly cut surfaces of one lot of seed pieces. The excess water was then squeezed from the moistened pieces of sacks and a drop placed on the eyes of another lot of seed pieces. The water from the contaminated sacks was pricked into these eyes with a sterilized needle. Both lots of inoculated seed pieces were planted in the greenhouse and the plants which resulted were examined for the presence of ring rot. The organism, in all but at the 70° F. temperature, remained viable and capable of infecting potato seed pieces. Table 5. The organism did not remain viable in the 70° F. chamber up to 200 days. In contrast, it did remain viable when exposed to the low temperatures and severe conditions that existed outside during the winter of 1942-1943.

There was no significant difference in the amount of infection secured from pure cultures or from infected potato tubers. There was, however, a significant difference in the amount of infection which resulted from the two methods of inoculation. Pricking the inoculum into the eyes with a sterile needle was more effective in producing the disease than was rubbing or contaminating the freshly cut surfaces of the seed pieces.

Added information was secured regarding the length of time the ring-rot organism can remain viable on potato bags stored under different conditions. Twelve-inch pieces of burlap and cotton potato bags were used. The pieces of bags were badly contaminated with the decayed material from tubers infected with ring rot and then subjected to different conditions similar to those referred to in Table 5 excepting that a 50° F. bin was included.

The potato bags were contaminated and put into storage on February 18, 1943, and the seed pieces were inoculated using these bags 115 days later on June 12, 1943. The two methods described previously were used for inoculating the seed pieces. The ring-rot organism remained viable for the duration of the experiment at all of the different temperature conditions. Table 6. The organism was not destroyed by exposure to the intense outdoor cold of the winter of 1942-1943 nor by a temperature of 70° F. in the storage bins.⁵ More infection resulted from the "eye prick method" than from rubbing the freshly cut surfaces of the seed pieces.

LEAFROLL, INCLUDING NET NECROSIS. *Resistant Varieties.*⁶

Donald Folsom. The test of new seedlings for leafroll resistance is made at Highmoor Farm where this virus disease spreads much more readily than it does in Aroostook County. There were 2,128 new seedlings in the test for the 1943 season. Of these, 333 had come forward from previous years back as far as 1939. These are all that are left from a total of 6,791 under trial during the period 1938 to 1942 inclusive. In 1943, 1,795 new seedlings were introduced to this test for the first time. Of these 1,678 had as one parent the seedling X247-48 which showed no leafroll in 1942 and only 1 per cent in 1943. It, also, has shown reasonably good cooking quality, good tuber shape, and fair yielding ability in preliminary tests. Over half of the 1943 introductions had as one parent one of the commercial varieties Green Mountain, Houma, Sebago, Sequoia, or Katahdin. Selections with desirable commercial qualities combined with leafroll resistance should be more numerous in this material than in any tried so far.

There are 18 new seedlings that have come through the Highmoor Farm leafroll test and which are thought to be worthy of yield trials and other more advanced tests. These 18 are highly resistant to leafroll.

Selection in the Green Mountain for Resistance to Net Necrosis. A. Frank Ross. Several healthy tubers of each tuber line used in the stem-end browning selection experiment were planted in an exposure plot where alternate rows were planted with tubers with leafroll. In 1942 over 95 per cent leafroll infection was obtained

⁵ The same bags were used to inoculate potato seed pieces January 20, 1944.

⁶ See footnote No. 4 on page 213.

in the tuber line selections. In both 1942 and 1943 the tuber lines varied greatly in net necrosis content but there was no correlation between the behavior of a given tuber line one year and that of the next year. In other words, all tuber lines appear to be equally susceptible to the development of net necrosis. Neither did the tuber lines differ in susceptibility to leafroll infection. Only 5 tuber lines were free of net necrosis for two years. There is a slight chance that one or more of these may be resistant to the development of net necrosis.

Fertilizer in Relation to Net Necrosis.⁷ Joseph A. Chucka, Arthur Hawkins, Michael Goven. On the permanent fertility plots the 1943 net necrosis readings varied from less than 1 per cent to about 15 per cent of the tubers examined. In the tuber samples taken from the rate of fertilizer application series there appeared to be a tendency for the number of tubers with net necrosis to increase as the amount of fertilizer used in producing the tubers was increased. Table 7. A similar tendency was observed when the amount of phosphorus in the fertilizer used was increased. On the remaining permanent plots there was considerable variation from plot to plot but the variation was not consistent with the variations in fertilizer treatments used.

The addition of borax to either fertilizers or sprays used in the production of potatoes apparently had no effect on the amount of net necrosis in the tubers produced.

In the source-of-potash test, Table 8, there was somewhat less net necrosis in the tubers produced with fertilizers which were either low in or free of chlorides than in those produced with fertilizers high in chlorides.

Fertilizer Treatment, the Spread of Leafroll, and the Net Necrosis/Leafroll Ratio. A. Frank Ross. Samples (3 to 6 bushels) of the Green Mountains produced on the permanent plots in 1942 were planted for leafroll counts in 1943. Table 9. Increased rates of fertilizer application increased the amount of net necrosis, the amount of leafroll spread and the NN/LR⁸ ratio. Of the 3 common fertilizer elements, phosphorus seems to have the greatest

⁷ Several of the studies with fertilizers are cooperative with the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture. Doctor Arthur Hawkins and Doctor Bailey E. Brown are the Bureau representatives on these studies.

⁸ NN stands for net necrosis and LR for leafroll.

influence on spread of leafroll. Nitrogen and potassium had little effect with the exception of where these elements were entirely lacking in the fertilizer. Phosphorus was not the only factor, for the plots on which chemically pure salts were used gave lower leafroll readings and also a lower NN/LR ratio compared to the 4-8-8 plot. In comparison with sulfate, chloride increases the NN/LR ratio but does not appreciably affect the spread of leafroll. Current recommendations favoring a reduction in the amount of phosphate in the fertilizer would appear to be desirable in that it would tend to decrease the spread of leafroll.

Mercury Salts in the Fertilizer. A. Frank Ross. Treatments which included mercury salts in the fertilizer were all ineffective in reducing the amount of net necrosis. Table 10.

Differentiation of Net Necrosis and Stem-End Browning. Emily M. Bartlett, A. Frank Ross. It was observed in preparing samples for examination that blocks of tissue from stem-end browning tubers floated in solutions which would not support comparable blocks from tubers with net necrosis. Consequently a study was made of the specific gravity of sections taken from various regions of the two types of tubers. Specific gravity was determined by floating the sections in sugar or salt solutions of known specific gravity. Table 11. Good differentiation was obtained with sections taken just beneath the stolon scar provided none of the corky scar tissue was included. An attempt is being made to develop a simple rapid test based on these data to differentiate between net necrosis and stem-end browning. At present the following method seems satisfactory. A thin slice is first removed that includes the stolon scar but which goes no deeper. A further slice about 1/10 inch thick is taken and the non-necrotic area around the outside trimmed off, leaving a disc about $\frac{3}{4}$ inch in diameter, if necrosis is well developed, but no smaller than $\frac{1}{3}$ inch where necrosis is slight. If the disc floats in a salt solution of specific gravity 1.034 (6.9 oz. per gal.), stem-end browning is indicated, and if it sinks, net necrosis. If both stem-end browning and net necrosis are present in the same tuber, the disc will either float or sink very slowly. This is a tentative procedure and further attempts at improvement are being made.

Detection of Tubers Infected with Leafroll Virus. A. Frank Ross, Emily M. Bartlett. Tubers infected with leafroll virus do not differ in specific gravity from healthy tubers of the same lot. This

is true not only when whole tubers are compared but also when small blocks from different parts of the tuber are compared. Microchemical tests and histological examinations have as yet provided no consistent basis for differentiating between diseased and healthy tubers. Xylem, phloem and starch grains in leafroll infected tubers appear to be normal. All chemical tests that showed promise at first have proved unsatisfactory in repeated tests.

Minor Elements. A. Frank Ross. The various applications of borax, Table 12, had no consistent effect on net necrosis. Likewise, most of the minor elements that were applied in sprays, Table 13, had no effect. However, potassium iodide and chromium sulfate both reduced the amount of net necrosis very appreciably. In the case of the former, this was probably due to the early killing of the tops by the iodide. The chromium salt, however, did not injure the tops or decrease the yield. Salts of chromium therefore are worthy of further study.

New Varieties and Net Necrosis. Donald Folsom, Michael Goven. The appearance of considerable net necrosis in the Green Mountain variety has been responsible, in great measure, for the turning by growers to the newer varieties such as Katahdin, Sebago, etc. It has been generally considered that these newer varieties do not develop net necrosis although susceptible to the leafroll disease. Tests in 1942 and 1943 tend to confirm the general impression that several of the newer varieties can be grown with the assurance of a reasonable freedom from net necrosis. Table 14. The Sebago may develop net necrosis in around 5 to 8 per cent of the tubers. Tubers of Katahdin, Sequoia, and Chippewa remain practically free of net necrosis even with an appreciable increase in leafroll spread. A small sample of Mohawk showed 0.5 per cent of net necrosis tubers.

The net necrosis which develops in the Cobbler and Green Mountain varieties is not an accurate index of the amount of spread of leafroll. In the Cobbler the net necrosis may indicate only 20 to 40 per cent of the leafroll spread. Table 15. In the Green Mountain 75 per cent of the current season spread of leafroll may be evident as net necrosis. The range in the net necrosis-leafroll ratio, however, is too great to permit one to judge the leafroll increase from the net necrosis per cent.

Storage Temperatures and Net Necrosis. Donald Folsom, Michael Goven. The results on storage temperatures for the 1943-

1944 season confirm those obtained in previous years. It appears that a conditioning period of 60 days at either 70° F. or 32° F. will inhibit the development of net necrosis in Green Mountains. At the 32° F. temperature a 30-day period was apparently just as effective as a 60-day period. However, the 30- and 15-day periods at 70° F. were not effective. Tables 16 and 17. A temperature of 36° F. was not quite as effective as the 32° F., but for practical purposes the 36° F. may be more readily attainable. Samples of Green Mountains held at 32° F. for 60 days showed from 0 to 0.1 per cent net necrosis while samples from the same field when held at 50° F. ranged from 17.6 to 22.7 per cent. At the 36° F. temperature the tubers with net necrosis ranged from 0.0 to 3.5 per cent. It is likely, however, that to obtain the comparatively low temperature of 32° or 36° F. immediately following digging time will require the use of some artificial means of refrigeration in many Maine potato storages. After the 60-day conditioning period the temperature of the storage is apparently of little importance so far as the development of this defect is concerned.

The peak of the seasonal curve for the development of net necrosis was reached in 80 to 100 days after digging. Some of the net which develops early in the season may fade out later. Table 18. Potatoes in one series which showed 36 per cent net after 91 days in storage showed only 28 per cent after 219 days. The reduction in no case was sufficient to warrant one in holding Green Mountains with the hope that this defect will disappear or become negligible.

Aphid Biology and Aphid Control.⁹ Geddes W. Simpson, Wayland A. Shands, Theo E. Bronson. There are four species of aphids which carry the leafroll virus from diseased potatoes to healthy ones. These are the peach, the buckthorn, the potato, and the foxglove aphids.¹⁰ Information on the relative importance of these aphids, their overwintering host plants, weed host plants, their habits of movement, factors affecting increases in populations, etc., all will be helpful in devising means for aphid control, if such

⁹ The studies on Aphid Biology and Aphid Control are cooperative with the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. Mr. Wayland A. Shands and Mr. Theo E. Bronson are the Bureau representatives on these studies.

¹⁰ The peach aphid, *Myzus persicae* (Sulz.); the buckthorn aphid, *Aphis abbreviata* Patch; the potato aphid, *Macrosiphum solanifolii* (Ashm.); and the foxglove aphid, *Myzus pseudosolani* Theob.

can be devised, and, also, in seed production programs. The early-harvest operation in seed production is one item which depends very largely on data on the time when winged aphids begin to appear and to move in appreciable numbers.

Surveys revealed that aphids were much less abundant on potatoes in northeastern Maine in 1943 than in 1942 and that their feeding damage was of relatively minor importance to the 1943 potato crop. Aphid eggs were even more scarce in the spring of 1943 on certain winter carry-over hosts than they were on the same plants in the fall of 1942. They were considerably more abundant on these plants in the fall of 1943 than in the fall of 1942. Table 19. Shriveled eggs, which do not survive, were most abundant in the fall of 1943 on buckthorn and less abundant on Scotch rose and wild plum. The abundance of aphid eggs in the fall on overwintering hosts is an index to the potential populations for the following season, although the correlation with actual populations may not be very close due to many factors affecting the survival of aphid eggs.

Studies on the wild plum disclosed in one thicket 86.7 per cent of the aphid infestations caged at random were the green peach aphid. The mature winged, or migratory, forms began to appear about June 15 and the peak of maturation occurred during late June and early July. The under-growing tender foliage of wild plums was found to serve as a summer host of the green peach aphid and about ten other species including the green potato aphid.

Two species of wild-growing roses were found to be hosts for the potato aphid and one other species of aphid.

Weeds were again studied from the standpoint of their importance as summer hosts for aphids. Weeds growing in crimson clover and potatoes were of importance as aphid hosts but those in oats or English peas were of minor importance.

Three varieties of potatoes growing in one field were found to vary in importance as aphid hosts. Heavier infestations of the peach aphid were found on the Chippewa than on Katahdin or Green Mountain. Katahdins were also more important in this respect than the Mountains. The Green Mountain, however, had more of the buckthorn aphid than either of the other varieties.

The use of insecticides in the Houlton area during the 1943 season did not show the large yield advantages as in previous years due, no doubt, to the comparatively light aphid population. On most of the farms where tests were made, there was some advantage

in yield. Table 20. In general, the percentage of both net necrosis and leafroll was higher in check plots than in the treated plots. Table 21.

Florida Test.¹¹ Wesley F. Porter, Donald Merriam, Geddes W. Simpson, E. L. Newdick. The number of samples entered in the test in 1943 and the acreage the samples represented were the largest since the test was started in 1937. The increase of 215 samples over the number entered in 1942 was due (1) to a greater interest in the test on the part of the seed growers and (2) to the requirement of the State Department of Agriculture that all fields of the Chippewa variety passing field inspection be tested in Florida under rules and regulations made by the Seed Certification Service.

One hundred eighty-seven different growers entered a total of 626 samples in the 1943-1944 test. Ninety of the samples entered were taken from the seed plots entered in the 1943 Foundation Program. Eighteen samples were from experimental plots. Five hundred eighteen samples were taken from tuber unit plots or from fields that were certified in 1943. The acreage and varieties represented by the samples were: 38 acres of Bliss Triumph; 1,646.7 acres of Chippewa; 1,914.6 acres of Green Mountain; 24 acres of Houma; 1,915.5 acres of Irish Cobbler; 1,465 acres of Katahdin; 18.5 acres of Russets; 692 acres of Sebago; 63.6 acres of Sequoia; 8 acres of White Warba; 1.5 acres of Mesaba; and 0.5 acre of Mohawk. The total area represented by samples was approximately 7,800 acres.

Planting in 1943 was completed on December 2. This is about the latest date potato samples can be planted in Florida to obtain final readings before February first. A heavy frost on December 19 injured about 50 per cent of the plants of the Chippewa and Sebago varieties. The frost injury and unfavorable weather conditions delayed final readings about two weeks. Good readings were, however, obtained on all samples. Final readings were made on the Chippewa and Sebago varieties by January 17. The readings were completed for other varieties by January 27.

In general the leafroll virus was found in higher percentages than any of the other common virus diseases. The readings on the Green Mountains indicated a slight increase in the amount of mosaic virus in 1943 as compared with several previous years.

¹¹ Cooperative with the State Department of Agriculture.

A summary of the number of lots of seed by variety and acreage entered in the 1941-1942-1943 Florida Tests and the number of lots and acreage of each variety recommended for table stock or for certified seed are given in Tables 22, 23, and 24.

It is of interest to note that 55 per cent of the total acreage entered in the 1943-1944 test did not exceed a total of 2 per cent in virus diseases. Ninety-two per cent of the total acreage represented did not exceed 10 per cent leafroll. Only eight per cent of the total acreage failed to receive a recommendation for use as certified seed or for growing table stock.

Genetic Variation in Potatoes as it Influences the Reproduction Rate of Plant Lice. Charles L. Hovey, Geddes W. Simpson. Results of the season's work indicate that there is definite, measurable variation between different varieties as expressed by means of counts of aphid populations resulting from artificial infestation of caged potato plants. The potato species, *Solanum polyadenium*, was found, for example, to be quite unsuitable as a host for the green peach aphid. At no time during the summer, in spite of re-infestations, was this aphid able to establish itself on plants of this potato species. An attempt is being made to have this species crossed with certain commercial varieties to incorporate this resistance into varieties having other desirable characteristics. At the other end of the scale, some varieties, Katahdin for example, were completely killed by the multiplying aphids* within a period of 6 weeks after aphids were first placed on caged plants. In other words, Katahdin is very favorable for the rapid reproduction of the green peach aphid. In between these two extremes there are other wild potato species and commercial varieties whose reactions to aphid populations vary from highly resistant to extremely tolerant.

Genetic Resistance to Insect Injury in Potatoes. Geddes W. Simpson, Charles L. Hovey. In recent years, aphid populations in Aroostook County have been dense enough to cause more or less direct injury to potatoes. Over a period of years observations of various varieties planted in plots for tests in connection with the National potato breeding project have indicated considerable variation in the reaction of different varieties to aphid feeding. Still more recently, a technique for the determination of relative injury to potatoes by aphid feeding was developed at the Dominion Experimental Farm at Fredericton, New Brunswick, and made available to the Maine Station.

A number of different potato varieties were obtained from the United States Department of Agriculture and from other sources. In all, there were 39 different lots of seed tubers. These were divided into two series, one composed of different potato varieties largely free from virus diseases, the other of a few varieties known to be infected with certain virus diseases, together with four lots of seed free from latent mosaic.

Each lot of seed tubers was divided among four cages, two seed pieces being planted in each cage. The 156 cages used were placed in six parallel rows. The particular variety used for planting each cage was determined by a system of restricted randomization. Two cages of the four used for each variety were later colonized with green peach aphids. Of each pair, one cage was covered with fine wire and one with muslin.

The results obtained show that the varieties used in this test may be placed in four fairly distinct classes. One, *Solanum polyadenium*, may be classed as immune to aphid damage. Another group, including Houma, Parnasia, and Burbank, was classed as resistant, showing little injury and supporting but small populations of aphids. A third group, including Mesaba, Sequoia, Netted Gem, Golden, President, Cobbler, Chippewa, Columbia Russet, Shamrock, Dakota Red, Bliss Triumph, and Blue Christie was tolerant, showing some injury and supporting larger populations than the resistant group. A fourth group, classed as susceptible, including Katahdin, Mohawk, Sebago, McKeller Seedling, *Solanum caldasi glabrosum*, USDA Seedling 41956, Green Mountain, Pontiac, and Pawnee, was found to be severely damaged in the relatively short time of four weeks. In many instances, the plants were actually killed in six weeks, after showing veinal blackening, rosetting, and leaf drop, all in severe degree. Large numbers of winged green peach aphids were usually associated with these plants.

The actual data summarized on a weekly basis, which were used in the classifications indicated, are given in Tables 33 and 34. There is considerable promise from this line of approach of finding, eventually, a seedling that will have desirable commercial qualities combined with resistance to aphid injury and that will not support large aphid populations.

STEM-END BROWNING. *Source of Seed.* A. Frank Ross. Different lots of Green Mountains vary greatly in susceptibility to stem-end browning. No lot has been found that is entirely free of

the disease. The more resistant lots in general produce about $\frac{1}{4}$ to $\frac{1}{3}$ as much stem-end browning as the more susceptible ones. The relative susceptibility of different lots is fairly constant from year to year. However, seed obtained from Minnesota increased in susceptibility very slightly when grown in Maine for one year, after which it produced the same amount of stem-end browning as other resistant lots obtained within this State. If a grower consistently finds a high percentage of stem-end browning in his potato crop, the situation can be considerably improved by changing to seed known to be less susceptible to the disease. Both types yielded equally well.

All Irish Cobbler lots that were examined are quite susceptible to stem-end browning.

Tuber Lines. A. Frank Ross. Records on several hundred tuber lines indicate that all Green Mountain tuber lines may be grouped into two general classes, those fairly resistant to stem-end browning and those that are highly susceptible. Most lots were made up of either one or the other type although a few lots were found that were apparently mixtures. Rarely, if ever, would it be possible to materially reduce stem-end browning in a potato crop by discarding seed tubers showing the disease and planting only clear-fleshed tubers.

Resistance to Stem-End Browning. A. Frank Ross. Although all tuber lines apparently fall into two general classes, this does not preclude the possibility that a few tuber lines may be completely resistant to the disease. Thirty-one Green Mountain tuber lines have been entirely free of stem-end browning for the two years during which records were kept. Of the several lines for which records have been kept for 3 years, 3 tuber lines have been free of the disease for that length of time. Sufficient quantities of these selections are now on hand to permit more rigorous tests in 1944. Additional tuber lines are introduced each year. Irish Cobblers were entered in the program in 1943.

Minor Elements. A. Frank Ross. Several minor elements were applied as a spray to Green Mountains. Three applications of each material were made unless leaf injury was noticed. The materials were applied in water solution. In no case was there any significant increase or decrease in stem-end browning. Table 13. Thus it seems improbable that the defect is the result of a deficiency or to the toxicity of zinc, molybdenum, manganese, iodine, cadmium,

chromium, or strontium. However, the plots sprayed with strontium gave a significantly higher yield. Also, when this element was applied with the fertilizer in 1942 an increased yield was obtained. Salts of this element are relatively inexpensive, hence it may prove practical to use this substance to increase yields. More experiments are necessary before recommendations can be made.

Borax as a Spray. A. Frank Ross, Reiner Bonde, Joseph A. Chucka. In view of the possibility that ordinary spray materials mixed with borax in the sprayer tank might render the boron unavailable, borax alone in water solution was applied to some plots. These were applied three or four days after the regular applications of Spray-Cop. A wide range of borax concentrations and number of applications was used. The first applications were made when the plants were in bud. The amount of stem-end browning was not reduced by any of the treatments. The higher rates of application caused burning of the leaves and a reduction in yield. Table 12. It seems quite improbable that stem-end browning can be controlled by the application of borax as a spray.

It appeared desirable, also, to study the addition of boron to potato plants in sprays used for the control of late blight. The amounts of boron used were 0, 1, 3, and 6 pounds of borax per 100 gallons of spray material. Ten replicated plots were sprayed with Bordeaux containing each of the above mentioned amounts of borax. Additional plots were sprayed with a basic copper spray with and without added borax. All plots were sprayed six times during the growing season. One-barrel samples of tubers were stored at 50° F. and later examined for stem-end browning and net necrosis. The data secured indicate no apparent effect of boron, applied in sprays, on the amount of stem-end browning or net necrosis in potatoes. However, the potatoes sprayed with basic copper developed considerably more stem-end browning than did those sprayed with Bordeaux mixture. Table 30.

Mercury Compounds Added to the Fertilizer. A. Frank Ross. Calomel, corrosive sublimate (HgCl_2) and yellow mercuric oxide were mixed with the fertilizer and the mixture applied in bands just prior to planting. Each of the three compounds reduced the amount of stem-end browning, and of the three calomel was the most effective. Table 10. The latter reduced the amount of stem-end browning from 44.8 per cent to 15.6 per cent. Corrosive sublimate and yellow mercuric oxide stunted the plants and reduced the

yield considerably while calomel did not reduce the yield significantly. These data show promise of developing methods for the control of stem-end browning and may possibly lead to the discovery of the cause of the disease. Recommendations must await further experimentation on rates, on the use of other fungicides and on danger of using such substances.

Growth Substances Applied to the Seed. A. Frank Ross. Reports from other areas have indicated that use of certain growth substances resulted in remarkable increases in yield. Several of these were tried during 1943 on Green Mountains and on Katahdins. Twenty-four hour treatment with concentrations of ethylene gas up to 30 per cent had no effect on yield, net necrosis, or stem-end browning with Green Mountains. When applied as a dust to cut seed Rootone,¹² Tubertone,¹² Hormodin No. 1 Powder,¹³ or Naphthalene Acetic Acid Dust N-2¹⁴ had no effect on yield with either Green Mountains or Katahdins and did not affect the amount of stem-end browning or net necrosis in Green Mountains.

Treatments by soaking the cut seed were more effective in respect to yield. Table 25. Indole butyric acid (0.01%) was toxic, especially when the seed was soaked 12 hours. Soaking the cut seed in 0.01 per cent indole acetic acid for one hour increased the yield 16 per cent but had no effect when the soaking period was extended to 12 hours. Transplantone had no effect on yield when the seed was soaked one hour but soaking 12 hours resulted in 24 per cent increase in yield. None of the treatments reduced the percentage of net necrosis or stem-end browning significantly.

Greenhouse Studies. A. Frank Ross, Frederick B. Chandler. Green Mountain tubers, selected from a lot known to be susceptible to stem-end browning, were planted in sand and nutrient solutions were supplied by the continuous flow method. Iron, zinc, manganese, copper, molybdenum, and iodine were supplied to all plants. The data are summarized in Table 26. All levels of calcium produced approximately the same amount of stem-end browning in the tubers indicating that calcium has no direct effect on stem-end browning. It would appear that the effect of lime in the field is due to factors other than the calcium supply. There was an increase in

¹² Supplied by American Chemical Paint Co., Ambler, Pa.

¹³ Supplied by Merck & Co., Inc., Rahway, N. J.

¹⁴ Supplied by American Cyanamid and Chemical Corp., New York.

stem-end browning with an increase in the amount of potassium supplied. As previously mentioned, chlorine was supplied at one level which was relatively low in comparison with potash when the latter was supplied at a high level. It would, therefore, seem probable that the harmful effect of high potash applications in the field is in part due to the potassium itself and not entirely due to the high chlorine content. This is in agreement with a previous greenhouse experiment in which stem-end browning was produced in the complete absence of chlorine. The data suggest an interaction between potassium and boron, as the plants grown with the low level of potassium and the high level of boron produced the most stem-end browning, and with the medium level of potassium the low level of boron produced the most stem-end browning. At the high level of potassium all three levels of boron produced a uniformly high amount of stem-end browning. Therefore under some conditions, it appears that boron may play a role in the development of stem-end browning but the amount of potassium in relation to the boron is also a factor. Boron deficiency symptoms were observed in a few tubers from plants supplied with the low level of boron.

Stem-End Browning as Affected by Fertilizers. Joseph A. Chucka, Arthur Hawkins, Michael Goven. Approximately one-barrel samples of tubers were taken from each of the permanent fertility plots at Aroostook Farm and from a number of other fertilizer experiments for the purpose of studying the effect of various fertilizer treatments on the development of stem-end browning during storage. All of these samples were stored at 50° F. in the experimental storage bins at Aroostook Farm from the time they were dug until examined for content of stem-end browning during March and April.

RATE OF FERTILIZER APPLICATION. Five of the permanent fertility plots received different amounts of 4-8-8 fertilizer and offered an opportunity to study the effect of rate of fertilizer application on the incidence of stem-end browning. The amounts of fertilizer used on these plots were none, 1,500, 2,000, 2,500, and 3,000 pounds per acre. Tuber samples from these plots developed stem-end browning in .6, 13.1, 36.7, 52.8, and 52.1 per cent of the tubers. These data are in general agreement with data secured from these plots in previous years and indicate that the incidence to stem-end browning tends to increase with the amount of fertilizer used. Table 7.

FERTILIZER RATIO. On four of the permanent plots nitrogen

was varied from 0 to 6 per cent while the phosphoric acid and potash were kept constant at 8 per cent. Tuber samples from these plots developed progressively more stem-end browning as the amount of nitrogen in the fertilizer used was increased. The range in per cent of tubers showing stem-end browning was 13.9, 24.1, 36.7, and 38.2.

Tuber samples from the plots varying in amount of phosphoric acid used in the fertilizer showed no definite trend in relation to per cent of tubers showing stem-end browning. Of the four plots in this series the one that received high phosphorus (4-12-8) produced tubers with the least stem-end browning.

In the potash series the percentage of tubers developing stem-end browning was definitely correlated with the amount of potash used in the fertilizer. The 4-8-0 treatment produced tubers which remained entirely free of stem-end browning. The 4-8-4, 4-8-8, 4-8-10, and 4-8-12 treatments produced tubers which developed respectively 3.7, 36.7, 48.2, and 58.6 per cent stem-end browning.

SOURCE OF POTASH. Plots which had received muriate of potash over a period of years produced tubers which developed about twice as much stem-end browning as did the tubers from plots which had received sulfate of potash as the source of potash in the fertilizer. A similar difference in amount of stem-end browning in tubers grown on these plots has been observed for several years. Thus it appeared advisable to substitute sulfate of potash for muriate of potash on some of the permanent plots to see whether or not such substitution would result in a reduction in stem-end browning. The five plots which have been cropped with potatoes every year since 1927 were selected for this purpose. In 1942 half of each of these five plots was treated with fertilizer containing sulfate of potash as the potash source and the other half continued to receive fertilizer with muriate of potash. The tubers produced with the two sources of potash on these plots in 1942 developed approximately the same amount of stem-end browning. The same procedure was repeated on these plots in 1943. The 1943 samples of tubers from these plots again developed nearly the same amounts of stem-end browning. The tubers produced with sulfate of potash showed only slightly less stem-end browning than those produced with muriate of potash. However, there was considerable difference in the depth to which the discoloration penetrated the tubers. Although the total number of tubers showing stem-end browning was nearly the same in the comparisons, the degree of stem-end browning development was

considerably less in those produced with sulfate of potash as the potash source.

In addition to the source of potash comparisons on the permanent plots tuber samples were taken from a source of potash test conducted on a commercial farm in Presque Isle. This test consisted of a comparison of five 5-8-12 fertilizer formulas each with a different source or combination of sources of potash. The sources of potash compared were (1) all from muriate, (2) half from muriate and half from sulfate, (3) one quarter from muriate and three quarters from sulfate, (4) all from sulfate, and (5) all from potassium nitrate and potassium metaphosphate. Thus the first four formulas had progressively less chlorine and more sulfate in them and the fifth was practically free of both chlorine and sulfur. Tuber samples from these five fertilizer treatments showed no significant difference in the number of tubers which developed stem-end browning.

BORON IN POTATO FERTILIZERS. Greenhouse data obtained in 1942 indicated that a deficiency of boron might be associated with the incidence of stem-end browning. To study this possibility further, potatoes were grown in 1943 with fertilizers containing different amounts of boron in the form of borax. The amounts of boron used were equivalent to 0, 5, 15, and 25 pounds of borax per acre. The potatoes produced with the fertilizers containing these amounts of borax developed stem-end browning in 21.1, 18.6, 15.4, and 8.6 per cent respectively of the tubers examined. These data indicate that the addition of borax to the potato fertilizers tends to reduce the amount of stem-end browning developed in the tubers but the use of borax in amounts greater than 5 pounds per acre resulted in appreciable reductions in yield of potatoes. Table 8. It might be possible to add boron to fertilizer in some less soluble form than borax and secure its apparent beneficial effect without seriously reducing yields.

Storage Temperatures. Donald Folsom, Michael Goven. Some of the storage temperatures that control net necrosis also control stem-end browning. An initial conditioning period at either 70° F. or 32° F. for 60 days practically inhibits the development of stem-end browning. A sample from one field when stored at 32° F. for 60 days showed no tubers with this defect while in another sample held at 50° F. for 60 days 30 per cent of the tubers developed stem-end browning. Tables 16 and 17. Samples were obtained from

three different fields and while there was a variation in stem-end browning from field to field the 36° F. and 32° F. storage temperatures were effective in inhibiting the development of this defect.

The temperature at 36° F., if feasible, will be found more satisfactory than the 32° F. temperature, particularly if other varieties such as Katahdin and Chippewa are to be stored along with the Green Mountains. The Katahdins and Chippewas may develop mahogany browning at the 32° F. temperature but apparently withstand the 36° F. condition satisfactorily. Table 35.

Soil Sterilization and Stem-End Browning. Donald Folsom. Soil from a field, that had grown stem-end browning potatoes recently, was sent to Orono where it was sterilized by steam. Potatoes were planted November 6, 1942, in both unsterilized and sterilized parts of this soil in the Aroostook Farm greenhouse and the crop was harvested March 9 and stored at 50° F. until June 16. All this was done with two batches of soil from two fields, respectively. The results were 15 per cent stem-end browning in sterilized soil versus 10 per cent in unsterilized; and 5 per cent stem-end browning in sterilized soil versus 0 per cent in unsterilized. Evidently soil sterilization did not reduce stem-end browning percentage.

LATE BLIGHT. The losses caused by late blight were relatively large in 1943. A survey made in Aroostook County by Dr. R. C. Cassell, revealed an average loss of 16 per cent in 110 potato storage bins where records on the amount of late blight rot were made.¹⁵ This large loss was experienced in spite of the fact that potato growers of Aroostook County spent more than \$1,000,000 for spraying potatoes for the control of this disease.

Late blight was not noted in the experimental spray plot on Aroostook Farm until August 12 and it was practically absent from commercial potato fields until the latter part of August. Many farmers stopped their spraying operations early in the season because late blight seemed to be absent. Favorable weather for the development of the disease prevailed after the middle of August and the disease became widely distributed by the latter part of August and the first week of September. In 1943 late blight spread rapidly and caused large losses in the form of reduced yields and tuber decay later in storage.

Late-Blight Tuber Rot in Storage. Reiner Bonde. It has

¹⁵ War emergency plant disease survey (Maine) January 23 to February 5, 1944. Report by R. C. Cassell.

been estimated that approximately 16 per cent of the potato crop of Aroostook County decayed in storage in 1943 because of late-blight infection. It is probable that most of this rot occurred because much of the crop was harvested while the foliage was still green and infected with late blight. A few infected potato leaves or stems in the field are sufficient to inoculate a high percentage of the tubers as they are being harvested.

The following results show the effect on the amount of late-blight tuber decay that may result from harvesting while the potato tops are still green.

TREATMENT OF TUBERS	PERCENTAGE TUBER DECAY IN STORAGE
Harvested and put into storage while part of foliage was still green and infected with late blight	48.0
Harvested and put into storage after foliage had been killed by frost	4.5

Potato Refuse Piles and Late-Blight Epidemics. Reiner Bonde, Eugene S. Schultz.¹⁶ Studies were continued in 1943 to obtain information pertaining to the role played by potato refuse piles in the spread of potato late blight. A campaign was conducted by the Farm Bureau and the Experiment Station for the purpose of eliminating the potato dump pile as a source of late-blight infection. Numerous potato refuse piles were destroyed in this campaign. As a result the appearance of late blight in the potato fields was delayed until late in the season.

However, because the disease appeared to be absent, many farmers relaxed their spraying program and many potato fields were poorly sprayed. The disease spread rapidly into these poorly sprayed fields and caused large losses.

Although the growing potatoes in many refuse piles were destroyed there were some that escaped and these served as a source of infection for nearby potato fields. In some cases cull potatoes were discarded in grain fields or some out-of-the-way place where they escaped detection in the survey. Potato growers should make

¹⁶ Senior Plant Pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.

a special effort to destroy the growing potatoes in the refuse piles and thus help to reduce the losses from late blight.

Treating Potato Refuse Piles in Control of Late Blight.

George P. Steinbauer. Complete elimination or proper treatment of potato refuse piles should be an important factor in delaying outbreaks of late blight, particularly early in the season. Experiments were carried out in 1943 to devise some simple, inexpensive, chemical dip treatments to kill the tubers and prevent further sprouting. Chemicals used were restricted to those that are readily available and inexpensive. They included copper sulfate, borax, sodium chloride or common salt, sulfate of ammonia, and ammonium nitrate. The copper sulfate, sodium chloride, and borax were used as saturated solutions. The sulfate of ammonia and ammonium nitrate were used as 20 per cent solutions. Peck lots of potato refuse, including whole tubers, sprouted seed pieces and partially decayed tubers were immersed in the solutions for periods of time ranging from $\frac{1}{2}$ hour to 24 hours. The treated material was then covered with about two inches of soil and observed later for sprout formation.

The only treatment which was successful in preventing sprouting in the material used was the twelve-hour dip in a saturated solution of common salt. Potatoes from all of the other treatments produced some sprouts even when immersion was extended to 24 hours. Dormant tubers were much more resistant to all treatments than sprouted tubers. The data so far obtained indicate that where only a few barrels of potato refuse are anticipated a satisfactory treatment would be to make a saturated brine solution and place the potato refuse into barrels of the solution overnight or longer. The refuse can then be skimmed off the solution and discarded. The solution can be used repeatedly, as long as some salt remains undissolved in the bottom of the container. The method is simple, inexpensive, and proved effective in preventing sprouting of all the lots so treated.

When the refuse material is badly decayed and difficult to handle or where the quantity is large it may be necessary to treat the material after it has been taken to the refuse piles. In certain localities it may be possible to bury the entire refuse heap under eighteen inches of soil, using power equipment. If the refuse has been hauled out in midwinter, freezing of the tubers should solve the problem. In this case the refuse should be scattered in thin

layers as deeply piled potatoes may escape injury and sprout in the spring.

If a large amount of combustible material such as hay or straw is available it may be piled on the refuse and burned, thereby killing the tubers. Here again the refuse material should not be placed in large heaps.

Where the cull potatoes have been discarded on rocky soil, along river banks, and in similar places it may be necessary to kill the sprouts by repeated applications of herbicides. The treatments should begin in early spring and continue as long as sprouts continue to emerge. It is doubtful if a single treatment with any chemical will be sufficient, particularly where large heaps of discarded potatoes occur. The following chemicals, sprinkled or sprayed on the tubers, have been found effective in destroying the sprouts; 1. *Sinox*, 2 gallons of concentrate to 100 gallons of water, to which is added 10 pounds of ammonium sulfate (previously dissolved in water); 2. *Dowspray "66,"* 6 pounds to 100 gallons of water; 3. *Ammonium sulfamate*, 1 pound to a gallon of water; 4. *Ammonium thiocyanate*, 1 pound to a gallon of water (somewhat corrosive to metals other than brass and aluminum); 5. *Sodium arsenite*, a 3 per cent solution (a deadly poison, use only where there is no danger of livestock poisoning); 6. *Sodium chlorate*, 1 pound to 5 gallons of water (a fire hazard, unless very carefully handled); 7. *Spent crankcase oil, creosote, kerosene*, and "*Meo 101*," full strength. A 10 per cent solution of blue vitriol can be used, if applied when the sprouts are young. However, it is not as reliable as the other chemicals mentioned and more applications will be required to obtain a complete killing of the sprouts.

Control of Late-Blight Tuber Rot by Killing the Tops with Weed Killing Materials. Reiner Bonde, Eugene S. Schultz. Many more farmers probably would "early harvest" their seed plots if an economical and efficient method were developed for killing the potato tops. These tops in the past have been killed by "hand pulling." This method is tedious, time consuming, and expensive and, therefore, has not been adopted by many farmers.

Some growers have attempted to harvest their seed plots by the use of machine diggers while the tops were still green in order to overcome the problem of pulling tops. This method is very precarious, however, because a large part of the crop may be lost from

late blight tuber rot if the plants have even a trace of late blight or "rust" on the foliage.

In 1940 two commercial growers who dug their seed plots while the tops were green experienced no loss from late blight rot and the potatoes kept well in storage. In 1941 they, however, lost most of their early harvested seed potatoes because the plots were dug while the foliage was green and slightly infected with blight. In 1943 approximately 50 per cent of the tubers from one seed plot decayed because they were dug while the foliage was infected with late blight. Farmers, therefore, are warned not to harvest their potato crop until the plants are dead and there is no danger of contaminating the potato tubers with the late-blight organism.

An experiment was conducted in 1943 to determine whether late-blight tuber rot can be controlled by killing the potato tops with a chemical weed-killer before the crop is dug. The results of this experiment are summarized as follows:

TREATMENT	PERCENTAGE OF TUBER DECAY
Tops killed, tubers dug and stored two days later ¹⁷	11.0
Tops killed as above but tubers dug 10 days later ¹⁷	2.7
Tubers dug while tops green and put immediately into storage	40.0
Tubers dug and put into storage after tops killed by frost	6.0

The data show that late-blight tuber rot can be greatly reduced by killing the infected tops before the crop is dug. When late blight is present the potato tops should be dead before the crop is dug. The tops may be killed by applying certain chemical weed-killers during years when maturity is delayed or when killing frosts occur late in the season.

Yield of Potatoes and Control of Late Blight Following a Reduction of the Copper and Lime Content in Bordeaux Mix-

¹⁷ Tops killed with Sinox manufactured by Standard Chemical Products, Inc., Hoboken, N. J. Used at rate of two gallons of Sinox and 10 pounds of ammonium sulfate in 100 gallons of water and applied at rate of 140 gallons per acre.

ture. Reiner Bonde, Clifford Soucy, Charles L. Hovey. The data secured from experiments conducted in 1943 confirm those secured in 1942 that the formula for making Bordeaux may be greatly reduced with no significant reduction in yield or in the control of disease.

The yield data for the experiments conducted in 1943 are summarized in Table 27. The yield was not significantly reduced by decreasing the formula for making Bordeaux from 10-5-100 to 4-2-100.¹⁸ Furthermore, late blight was satisfactorily controlled in all of the spray plots included in this experiment. It should be recalled, however, that in 1942 when late blight was very severe, Bordeaux mixture applied with a tractor spray outfit and made according to the 4-2-100 formula did not give good control of the disease although large yields were secured.

The information derived from experiments conducted so far indicates that the formula for making Bordeaux may be materially reduced if a good sprayer is used and if the fields are kept well covered with the spray fungicide.

Different Copper Fungicides at Various Concentrations.

Reiner Bonde, Clifford Soucy, Charles L. Hovey, Elmer R. Tobey, Bernie E. Plummer, Jr. Four fungicides and one fungicidal-insecticidal material were compared at three different concentrations of equal copper content. The results of these experiments have been summarized in Table 28. The highest yields for the three different concentrations of copper were secured with Bordeaux.

The plots sprayed with Bordeaux remained green longer in the season than did the plots which were sprayed with the other fungicides. Early-blight infection developed quite severely in all but the plots sprayed with Bordeaux, and the differences in yield appeared to be associated directly with the prevalence of this disease. The earlier maturity of the plants in the plots sprayed with the factory-made fungicides may be of some advantage in years when killing frosts come late in the season.

Determinations were made on the amounts of copper retained on the leaves of the potato plant when different forms of copper in varying strengths and in combination with other materials were

¹⁸ The first number of the formula gives the pounds of copper sulfate per 100 gallons of spray material, the second number gives the pounds of lime used per 100 gallons of spray material. The third number gives the gallons of water.

used in sprays for the control of late blight. Bordeaux, Copper Arsenate, Cuprocide, Basi-cop, and Spray-cop were the different forms of copper used. In some of the experiments lime was added to the copper materials and with Bordeaux the proportions of lime to copper were varied. In one experiment the effect of adding fish oil and soybean oil to copper arsenate was studied.

In all instances the plants that received Bordeaux had larger copper residues on the leaves than those that had been sprayed with other forms of copper. Lime added to Basi-cop increased the copper residue on the plant foliage. In the experiments with Bordeaux in which the amounts of copper and lime were varied, the results indicate that larger amounts of lime were an aid in retaining the copper on the potato leaves. Fish oil and soybean oil were both effective in materially increasing the amount of copper residue on potato leaves when added to copper arsenate spray.

Reaction of Potato Varieties to Different Copper Fungicides. Reiner Bonde, Clifford Soucy, Charles L. Hovey. Most of the spraying experiments conducted on Aroostook Farm in the past have been with the Green Mountain variety. Studies were begun in 1942 to determine whether the various varieties react differently to the different spray fungicides. The studies of 1942 indicated that the newer varieties do not respond to fungicidal spray materials in the same manner as does the Green Mountain variety, and that the recommendations might be different.

The data secured in 1942 indicate that the neutral copper sprays will result in significantly larger yields comparatively when applied to the Katahdins than when used to spray Green Mountains. Table 29. The data for 1943 do not confirm those secured in 1942. The Katahdin plots sprayed with neutral copper fungicides in 1943 did not yield more than those that had been sprayed with Bordeaux. The same was true for both Katahdins and Green Mountains.

Basic Copper Sulfate in Combination with Rotenone for the Control of Diseases and Insects. Reiner Bonde, Geddes W. Simpson, Elmer R. Tobey, Bernie E. Plummer, Jr. Plots of the Sebago variety were sprayed in 1943 with rotenone (4 pounds of Derris root containing 4.8 per cent rotenone) seven times during the season. Those to which rotenone was added to the fungicidal spray remained green longer in the season than did the plots which received only the fungicide. The addition of rotenone did not increase the amount of copper residue on the potato leaves. The in-

crease in the length of life of the plants resulted in an increased yield of over 9 barrels or about 25 bushels per acre. This increase was sufficient to more than pay for the rotenone that was used and the extra labor involved in making the applications.

Non-Copper Containing Spray Fungicides. Reiner Bonde, Clifford Soucy, Charles L. Hovey. Recently there has been some interest in the development of non-copper containing fungicides which can be used efficiently for spraying potatoes. In 1943 two organic fungicides, namely, Fermate and He 175 were compared with Bordeaux and Copper Oxychloride regarding their ability to control early and late blight on potatoes. The results of this test are summarized in Table 31.

Both of the organic spray materials possessed considerable fungicidal value and controlled the diseases early in the season. However, a considerable amount of early blight infection developed late in the season which resulted in a slight reduction in yield in comparison with the plots sprayed with Bordeaux or with Copper Oxychloride. The difference in the yield between the plots sprayed with the organic fungicides and those sprayed with Bordeaux or with Copper Oxychloride are not significant.

Storage Temperatures and Late-Blight Rot. Reiner Bonde, Donald Folsom. Previous studies made at Aroostook Farm indicated that the amount of late-blight rot is greatly reduced by storing the potatoes at low temperatures immediately after they have been dug. An experiment was conducted for the purpose of determining further whether storage temperature is a factor in determining the amount of decay that may occur.

During the fall of 1943, freshly dug potatoes were taken from a field which was badly blighted. The potatoes were placed in storage bins maintained at temperatures ranging from 32° F. to 70° F. The tubers in the different storage bins were examined later for the presence of late-blight rot.

The results of this test are as follows:

LATE-BLIGHT ROT DEVELOPED IN GREEN MOUNTAIN POTATOES STORED AT
DIFFERENT TEMPERATURES IN 1943¹⁹

TEMPERATURE OF BIN	LATE-BLIGHT ROT DEVELOPING IN STORAGE
degrees F	per cent
32	18
36	15
50	46
65	53
70	64
Commercial storage	58

Data on potatoes from another field are given in Table 32. It is apparent that a storage temperature around 32° to 36° F. for a period of 60 days is effective in reducing materially the loss from late-blight rot in storage.

PURPLE TOP. Reiner Bonde. Studies were continued in 1943 to obtain more information regarding the purple top disease.

Purple Top and Yield Rate in the Katahdin and Sebago Varieties. Hills having symptoms of purple top were dug during the fall of 1942 and stored in separate bags. The potatoes from the different hill lots were examined and separated into two lots, one lot consisting of the soft and wilted tubers and the other lot those tubers which were firm and appeared to be normal. The tubers of the different lots were put into storage and used for planting the experimental plot in 1943.

The firm tubers from purple top hills produced only 12 per cent normal plants in the Katahdin variety and 44 per cent normal hills in the Sebago variety. The soft tubers in the Katahdin variety produced no normal plants and 62 per cent failed to grow. In contrast the soft and wilted tubers from the Sebago variety produced 26 per cent normal plants and only 7 per cent failed to grow. Table 36. Furthermore, the firm tubers from purple top hills in the Katahdin variety yielded 106 barrels (291.5 bushels) or 56 per cent less than the healthy controls. The firm tubers from Purple Top Sebago hills reduced the yield only 14 barrels (38.5 bushels). The soft tubers from the diseased Katahdin plants yielded only 20 barrels (55 bush-

¹⁹ The potatoes were placed in storage September 15, 1943, and were removed April 8, 1944.

els) per acre contrasted with a yield of 72 barrels (198 bushels) per acre in the Sebago variety.

The results of 1943 confirm those secured earlier that purple top affects the Katahdin variety more than it does the Sebago. The disease when present in large amounts in Katahdin seed stocks results in a high percentage of very weak plants and missing hills. In the Sebago variety, the disease causes less dwarfing of the plants, there are fewer missing hills, and the yield rate is reduced less. It often happens that certain fields of Sebago have plants that are uneven in height and vigor and produce rather inferior yields. Such fields may have been planted with seed stocks from fields having a high percentage of purple top hills.

Studies conducted in previous years have indicated that seed stocks recover from the disease and produce normal or nearly normal crops. In 1943 a seed stock one year removed from purple top produced a crop that was about 85 per cent as large as that secured from the healthy controls. The seed stock which was two years removed from purple top yielded 55 barrels more per acre than did the healthy control seed stock. Table 36. The seed stock from purple top hills appeared to have recovered from the disease and 90 per cent of the plants were normal as to size and vigor.

The question naturally arises as to the reason that the seed stock which had recovered from purple top yielded so much more than did the controls. Observations made during the growing season showed that the healthy seed stock used as the controls produced mostly one and two stalked hills. The seed stock which had recovered from purple top produced from three to six stalks per hill. It is well known that the yield rate may depend to some extent on the number of stalks in the hill. It is possible that purple top may increase the number of stalks that are produced by the seed pieces. There is some evidence that the yield may be increased by harvesting the seed tubers while immature. The recovered purple top seed stock and the healthy controls were not harvested at the same date.

Purple Top and Stand in the Katahdin Variety. Additional information was obtained regarding the effect on the crop of planting seed tubers from plants that have the purple top disease. Hills having purple top were harvested from a field of Katahdins. The tubers from these diseased plants were sorted into three lots, namely, (1) those that were firm and seemed to be normal; (2) those that were slightly wilted; (3) those that were badly wilted or

"spongy." Observations were obtained just prior to planting to ascertain whether the sprouts which developed from these tubers were normal. The three lots of seed were planted separately and a record was obtained regarding the type of plant which was produced by each tuber. Table 37. Forty-four per cent of the tubers were firm, 20 per cent were slightly wilted, and 36 per cent were badly wilted and spongy in nature. Contrary to expectations, 70 per cent of the normal appearing tubers sprouted abnormally (either produced "hair sprouts" or entirely failed to germinate). Seventy-six per cent of the slightly wilted tubers failed to produce normal sprouts and 81 per cent of the badly wilted tubers failed to germinate and produce healthy sprouts.

The firm tubers from the purple top plants produced only 43 per cent normal plants, the slightly wilted tubers produced 50 per cent normal plants, and the badly wilted tubers produced only 3 per cent normal plants. Thirty-seven per cent of the firm tubers failed to grow and produce plants and 41 per cent of the slightly wilted tubers failed to grow. Eighty-one per cent of the badly wilted tubers did not grow. An additional 16 per cent produced very small dwarfed plants that gave no commercial crop.

It should be noted from the data in Table 37 that 95 per cent of the healthy control tubers gave normal plants and there were no missing hills or small weak plants. These data indicate that the tubers from purple top hills in the Katahdin variety are not fit for seed purposes. Even the firm tubers from diseased plants gave a high percentage of missing and non-productive hills.

Stand from Tubers from Healthy and Diseased Stalks of Plants Having Purple Top. It has been observed that often only a part of the stalks of potato plants are infected with purple top. Very often some of the tubers attached to the diseased stalks are wilted and spongy. The wilted tubers generally are nearest the surface of the soil.

A study was made to learn whether the effect of purple top on the seed tubers is restricted to the tubers which are borne on the stalks which have the disease. The tubers from the different lots were examined regarding sprout formation and then were planted in the field where observations were made regarding the plant symptoms and the stand that developed.

It is apparent that the effect of the disease is present, not only in the tubers from the diseased stalks, but also in some of the tubers

from the stalks that appear to be healthy. Table 38. In the Katahdin variety, 80 per cent of the tubers from the healthy stalks developed abnormal sprouts compared with 82 per cent for the tubers from the diseased stalks. Only 50 per cent of the tubers from the healthy stalks produced normal plants, 19.5 per cent of the plants were dwarfed and produced no crop, and 22.2 per cent remained dormant and failed to germinate. The tubers from the diseased stalks were affected more than were those from the healthy stalks. It may be noted that 37 per cent of the tubers failed to grow and an additional 36.8 per cent produced small plants and with no marketable potatoes. It may be noted also that purple top affected the Sebago variety less than it did the Katahdin. The healthy stalks from the Sebago plants produced only 6.8 missing hills compared with 22.2 per cent in the Katahdin variety. The seed tubers from the diseased Sebago stalks gave 8.8 per cent missing hills compared with 37.0 per cent missing hills for the Katahdin variety.

Recovery of Seed Stocks Having Purple Top. Studies were continued in 1943 to obtain additional information regarding the recovery of seed stocks having purple top.

Tubers of the Katahdin and Sebago varieties were harvested in 1941 and planted again in 1942. The tubers from purple top plants produced small dwarfed plants with very small yields. Some of purple top seed tubers in the Katahdin variety failed to produce plants but formed small tubers attached to the mother seed tubers.

Tubers were selected from this material and were planted in the field in 1943. Observations were made regarding the symptoms of the plants which developed. The results of this experiment are summarized in Table 39. The seed stocks infected with purple top in 1941 produced normal appearing plants in 1943. In experiments concluded in 1941 a Katahdin seed stock which had partially recovered from purple top yielded 85 per cent as much as did the healthy controls. In 1943 a Sebago seed stock which had recovered from the disease yielded 55 barrels per acre more than did the healthy controls. Table 37.

SEED DISINFECTION. Elmer R. Tobey, Bernie E. Plummer, Jr., Reiner Bonde. Samples of acid mercuric chloride solution used in treatment of seed potatoes at Aroostook Farm were analyzed for acid and mercuric chloride strength. Two sets of experiments were run in which the same solutions were used for twenty-five consecu-

tive dips without adding any additional mercury to the solution. One solution was made acid with acetic acid, the other with hydrochloric acid. Both proved equally effective in preventing the loss of mercury from solution.

FOUNDATION SEED PROGRAM. Wesley F. Porter, Donald Merriam, Geddes W. Simpson. As a partial answer to a need for more and better sources of good seed potatoes, growers and public agencies in Maine started, in 1939, a Foundation Seed Program to provide within the State a part of the foundation seed needed by growers for the production of certified seed. This program has been of considerable help in maintaining good sources of seed of the more common varieties of potatoes grown in Maine and in the introduction of several new varieties.

In 1943, 36 growers entered approximately 254 acres in the Foundation Program. The acreages and the varieties entered were 83.5 acres of Green Mountains; 43.4 acres of Sebagos; 40.8 acres of Katahdins; 38.0 acres of Irish Cobblers; 33.9 acres of Chippewas; 2.1 acres of Sequoias; and 2.0 acres of Bliss Triumphs. The total acreage was planted in 88 different plots. The plots were located in the Counties of Penobscot, Piscataquis, and Aroostook.

During the period from July 20 to digging time bacterial ring rot was found for the first time in five different lots of seed. It is believed that conditions in 1943 were unusually favorable for the development of the symptoms of this disease.

Experience has shown that early harvesting is one of the most important factors in the control of leafroll. Although there was considerable interest in killing tops with chemicals this year, all growers in the foundation program early harvested by pulling tops by hand. In 1943, early harvest dates ranged from August 10 to August 27. In several previous years, it has been necessary to complete this operation much earlier in the season. It is known, from studies conducted at Aroostook Farm, that aphid flights in central Aroostook did not become general until August 25. It seems evident that information gained from records of aphid flights can be used very successfully in determining the time when early harvesting operations must be started. Unsatisfactory results were obtained by early harvesting two plots in central Maine the last week in August.

Several growers early harvested the entire acreage entered by them in the program. Approximately 7,500 barrels of seed were

early harvested for planting in 1944. The results of the Florida Test show that the percentage of virus disease present in the 51 samples of early harvest seed tested, ranged from 0.0 to 0.7 per cent. The average percentage of leafroll virus present in the entire amount of seed early harvested was 0.09 per cent. The average percentage of total virus present was 0.17 per cent.

Samples were taken from the foundation plots and grown in Florida during the winter of 1943-1944 to determine the amount of virus disease present in the different lots. As a result of the readings obtained on these samples, it was found that 93 per cent of the acreage tested had a disease content much lower than the 2 per cent tolerance allowed for foundation seed. The remaining 7 per cent of the acreage tested showed a total virus reading under 3 per cent and was recommended for seed to be planted as table stock.

A summary of the acreage of each variety qualifying as foundation seed is given in Tables 40 and 41.

SOIL FERTILITY

FERTILIZATION. The record yield per acre of potatoes for the Maine 1943 crop is ample evidence that the potato industry as a whole is following reasonably sound practices for maintaining the productive capacity of the soil. Nevertheless, there is always the possibility for improvements from the standpoint of the yield and the quality of potatoes.

Permanent Plots.²⁰ Joseph A. Chucka, Arthur Hawkins, Ferdinand H. Steinmetz, Bailey E. Brown, Elmer R. Tobey, Bernie E. Plummer, Jr. The 1943 potato yields on the permanent plots are in general agreement with those secured in previous years as published in Bulletin 414. Two new studies were started on the permanent plots in 1943. One consisted of the use of a no-phosphorus mixture (4-0-8) and a very low phosphorus mixture (4-2-8) on plots which had previously been receiving 4-8-8 fertilizer on both the two- and three-year rotation series. The object of using these treatments was to study the availability of the residual

²⁰ The studies with potato fertilizers are cooperative with the Division of Soil and Fertilizer Investigations, and the Division of Fruit and Vegetable Crops and Diseases. Arthur Hawkins and B. E. Brown, respectively, are the representatives of these Divisions on these studies in Maine.

phosphorus accumulated in the soil as a result of the previous applications of a 4-8-8 fertilizer. The plots on both the two- and three-year rotation series which received the 4-0-8 mixture for the first time in 1943 produced somewhat higher yields than did the plot which had been receiving a 4-0-8 mixture over a period of 16 years. However, they produced lower yields than did the plots to which phosphorus was added. The plots which received the 4-2-8 mixture produced as high yields as did plots which received a 4-8-8 fertilizer. Thus the study indicates that the repeated use of a 4-8-8 fertilizer over a period of years results in an accumulation of some available phosphorus in the soil but not enough to eliminate the need for the application of at least some phosphoric acid.

The second new study initiated on the permanent plots in 1943 was a study of fertilizer placement. This study was started on the two-year rotation series and includes four plots. One plot receives all of its fertilizer in the row at planting time and serves as a check. On the second plot $\frac{4}{5}$ of the fertilizer was broadcast and harrowed in just prior to planting and $\frac{1}{5}$ was placed in the row at planting time. On the third plot $\frac{4}{5}$ of the fertilizer was applied broadcast and plowed under in the fall and $\frac{1}{5}$ was applied in the row at planting time. On the fourth plot $\frac{4}{5}$ of the nitrogen was applied broadcast and plowed under in the fall and $\frac{1}{5}$ of the nitrogen and all of the phosphorus and potash were applied in the row at planting time. Plots one, two, and four produced approximately the same yield. Plot three which received $\frac{4}{5}$ of its fertilizer the previous fall produced a somewhat lower yield.

Fertilizer Rate and Ratio Test. Joseph A. Chucka, Arthur Hawkins, J. Wilfrid Cyr, Bailey E. Brown. Fertilizer grades varying in nitrogen, phosphoric acid, and potash were compared on four farms in Aroostook County and on two farms in central Maine. The amounts of nitrogen used varied from 40 to 160 pounds per acre, the phosphoric acid from 40 to 180 and the potash from 100 to 280 pounds per acre. On the two farms in central Maine potato yields increased with increasing amounts of plant food applied up to 80 pounds of nitrogen, 120 pounds of phosphoric acid, and 160 pounds of potash per acre. These amounts of plant food would be contained in one ton of a 4-6-8 fertilizer. Three fertilizer grades (4-4-8, 4-6-10, and 4-8-12) were compared at 2,000, 2,500, and 3,000 pounds per acre on these same farms. The highest average yield for the two farms was produced with 2,000 pounds per acre of

4-6-10 but there was no significant difference in yield among either the three grades or the three rates of fertilizer used.

Soil samples taken from these farms prior to planting showed a low to medium low phosphoric acid content and a high potash content.

On the four farms in Aroostook County, yield responses were obtained with increasing amounts of plant food added up to 100 pounds of nitrogen, 120 pounds of phosphoric acid, and 160 pounds of potash per acre. On two of the farms in Aroostook three varieties of potatoes were grown on the rate-ratio test plots. The Chippewa and Sebago varieties showed a somewhat greater response to added phosphoric acid than did the Green Mountain variety.

Soil samples from these four farms taken prior to planting showed medium to medium high phosphoric acid and medium high to high potash.

Potash Source. Joseph A. Chucka, Arthur Hawkins, Bailey E. Brown. Five 5-8-12 fertilizer mixtures with different sources of potash were compared on one farm in Aroostook County. The potash in mixture No. 1 was derived entirely from muriate of potash, in mixture No. 2 it was $\frac{1}{2}$ from muriate and $\frac{1}{2}$ from sulfate of potash, in mixture No. 3 it was $\frac{1}{4}$ from muriate and $\frac{3}{4}$ from sulfate of potash, in mixture No. 4 it was all from sulfate of potash, and in mixture No. 5 it was derived from nitrate of potash and potassium metaphosphate.

All of the mixtures were applied at one ton per acre and ten replicated plots of each treatment were planted with Green Mountains and ten with Sebagos. Both varieties of potatoes produced a somewhat lower but not significantly lower yield on mixture No. 1. The other four mixtures produced approximately equal yields.

Phosphorus Source. Bailey E. Brown, Arthur Hawkins, Joseph A. Chucka. Fused rock phosphate of three different sized particles (6, 40, and 80 mesh) was compared with ordinary and triple superphosphate as a source of phosphorus in potato fertilizers on one farm in Aroostook County. All of these materials were used as sources of phosphorus in 5-4-10 and 5-8-10 fertilizer mixtures applied at 2,000 pounds per acre. The mixtures containing the three grades of fused rock phosphate produced significantly lower yields at both levels of phosphorus application than did those containing either ordinary or triple superphosphate. The coarse (6 mesh) fused rock phosphate produced the lowest yield at both

levels of phosphorus application. All of the 5-8-10 mixtures produced significantly higher yields than did the 5-4-10 mixtures indicating a need for more than 80 pounds of phosphoric acid (P_2O_5) per acre on the farm upon which this test was conducted.

Borax in Potato Fertilizers. Joseph A. Chucka, Arthur Hawkins. Although a number of previous tests conducted in Aroostook County showed little or no response from the use of borax in potato fertilizers another test was made in 1943 because of some indications that boron might be associated with the incidence of stem-end browning. The 1943 test consisted of a comparison of 0, 5, 15, and 25 pounds of borax per acre used in a 6-9-15 fertilizer applied at 1,334 pounds per acre on one farm in Aroostook County. The use of borax at 5 pounds per acre had no significant effect on potato yield. However, both the 15 and 25 pound applications resulted in a highly significant reduction in yield.

Fertilizer Placement. Joseph A. Chucka, Arthur Hawkins, Bailey E. Brown. A fertilizer placement study with potatoes was conducted at Aroostook Farm in 1943. The fertilizer placements compared consisted of (1) the standard method in which all the fertilizer is applied in the row at planting time in bands two inches to the sides and slightly below the seed pieces, (2) where $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$, or none of the 2,000 pound application was applied in the row with the remainder in each case being applied in a single 2 inch band on the plow sole (14" bottom plow) a few days prior to planting, (3) all of the fertilizer applied broadcast prior to plowing, (4) all of the fertilizer applied broadcast after plowing and harrowed in, (5) part of the nitrogen and potash applied in a single band on the plow sole and the remainder of the nitrogen and potash and all of the phosphorus applied in the row at planting time.

The fertilizer grade used in this test was a 6-6-12 and it was applied in each case at a total of 2,000 pounds per acre. All treatments were applied on duplicate 18' x 80' plots. Seventy-five feet of the four middle rows of each plot were harvested for yield data.

The yields obtained with the various placements are presented in Table 43. All the treatments with the exception of number 5 in which all of the fertilizer was applied on the plow sole produced as high or higher yields than the standard method. However, only treatment number 6 produced a significantly higher yield (that was barely significant) than the standard method. Thus one is not warranted in drawing any conclusions from these data.

The unusually favorable growing season particularly with respect to very well distributed rainfall may have been responsible for the relatively high yields produced with the broadcast applications. The relatively low yield produced with treatment number 5 may be an indication of the desirability of placing at least part of the fertilizer in the row near the seed pieces.

A comparison of the yields on treatments 5 and 6 suggests that the placement of all of the fertilizer in a single narrow band on the plow sole makes the fertilizer relatively inaccessible to the roots of potato plants. It would appear desirable to try the use of either several narrow bands or one wide band on the plow sole in addition to placing part of the fertilizer in the row.

Salt Index Experiment. Joseph A. Chucka, Arthur Hawkins, Colin W. Whittaker, Bailey E. Brown. It is a well-known fact that a large amount of chemical fertilizer placed in contact with or near a seed, seedling, or seed piece will injure the growing plant. This type of injury is often called "fertilizer burning." The degree of injury varies with such factors as kind and amount of fertilizer used, the particular kind of seed or seedling, the relative position of the fertilizer to the seed or seedling, the type of soil, the amount of moisture in the soil, etc. Research work on fertilizer placement has shown that this injury may be entirely avoided by placing the fertilizer a certain distance away from the seed, seedling, or seed piece. For example, in fertilizing potatoes this injury may be entirely avoided by placing the usual amounts of fertilizer two inches to the sides of and slightly below the seed pieces.

Within recent years the relative "burning effect" of the various ingredients used in making fertilizers has been evaluated. Using this information it is possible to calculate the salt index (the relative burning effect) of any fertilizer from a knowledge of the materials used in making up the fertilizer. Likewise by the proper choice of fertilizer materials it is possible to make up fertilizers with either a low or a high salt index.

The salt index experiment conducted on one farm in Aroostook County in 1943 consisted of a comparison of two fertilizer grades (4-6-10 and 8-12-20) each made up with a low and a high salt index at two levels of fertilizer application applied in bands one inch and two inches from the seed pieces. The data secured are presented in Table 44.

In general the single-strength fertilizers with a high salt index

produced somewhat lower yields than did those with a low salt index. With both grades the lower rate of fertilizer application produced slightly higher yields than the higher rate of application. Equivalent amounts of plant food in the 8-12-20 grades produced somewhat higher yields than did the 4-6-10.

Because of a very favorable growing season rather good yields were obtained with all treatments. Larger differences in yield between the fertilizers of low and high salt index might be expected in a dry season.

These data indicate that comparatively large amounts of fertilizer may be used in the row at planting time without serious injury under Aroostook conditions especially when placed in bands two inches to the side of the seed pieces.

Nutrient Elements in Stands of Potatoes and Amounts Removed in Tubers. Arthur Hawkins, Bernie E. Plummer, Jr., Elmer R. Tobey. Determinations of the rate of absorption of mineral elements by different varieties of potatoes have been reported in a previous progress report.²¹ Mineral analyses were made on samples of potato plants taken during the first week of September, 1943, from fields having different varieties of potatoes of excellent stand and growth. The purpose of obtaining additional data was to estimate the mineral nutrient content in excellent stands of potatoes, during an exceptionally favorable growing season, and to approximate the removal of these nutrients in tubers of such excellent crops. The yields of tubers and the mineral nutrient content of the non-tuber portions and the tubers, separately, in an acre of potatoes at the time of sampling are presented in Table 45. Some of the leaves of the earlier variety, Chippewa, had dried up and were lost at the time of sampling. The yields of the later varieties, Green Mountain and Sebago, increased considerably after this date of sampling. Samplings were not made in such manner that true comparisons can be made between varieties relative to total amounts of nutrients absorbed during the season. The fertilizer applied for the potatoes supplied per acre: 100 pounds of nitrogen, 150 to 200 pounds of phosphoric acid, 250 to 300 pounds of potash, and 30 to 40 pounds of magnesium oxide. As a result of a larger crop, much larger quantities of nitrogen and particularly potash were found to be contained in an acre of potatoes in comparison to those previously reported.

²¹ Me. Agr. Expt. Sta. Bul. 405: 477-481, 1941.

The amounts of nitrogen and particularly potash that are removed from the field in a barrel of potatoes are quite considerable in comparison to those of the other mineral nutrients determined. According to the analyses made on and obtained for the 1943 samples, each barrel (approximately 3 bushels) of potatoes contained about 1 pound of potash; slightly more than $\frac{1}{2}$ pound of nitrogen; $\frac{1}{7}$ pound of phosphoric acid; $\frac{1}{15}$ pound of magnesium oxide, and only about $\frac{1}{60}$ pound of calcium oxide. In terms of yields of about 200 barrels (550 bushels) per acre, the mineral nutrients removed would be about 200 pounds of potash; 100 to 110 pounds of nitrogen; 30 pounds of phosphoric acid; 13 pounds of magnesium oxide, and about 3 pounds of calcium oxide.

GREEN MANURE CROPS IN CENTRAL MAINE. Joseph A. Chucka, Arthur Hawkins, J. Wilfrid Cyr. A green manure crop variety trial was conducted on one farm in central Maine in 1943. The crops compared were Japanese millet, field corn, sunflowers, oats, buckwheat, mixture of oats, peas and vetch, and rye grass. These crops were grown with three levels of nitrogen (0, 50, and 100 pounds of nitrogen per acre) and with the same three levels of nitrogen, phosphoric acid, and potash in the form of 10-10-10 complete fertilizer. As might be expected the yields of all crops increased with increasing amounts of either nitrogen or complete fertilizer used. Nitrogen alone produced nearly as high yields as did the complete fertilizer. In terms of yield of dry matter produced the rank of the crops in descending order was as arranged above. When fertilized with 50 pounds of nitrogen per acre Japanese millet produced nearly five tons of dry matter per acre.

SEED STOCK PRACTICES

There is considerable interest in methods for making the best use of seed stocks. There are various opinions as to the best size for seed pieces and as to the best rate of planting to obtain maximum yields.

SIZE OF SEED PIECE AND POTATO YIELDS. Ferdinand H. Steinmetz, Arthur Hawkins, Bailey E. Brown, Joseph A. Chucka. The increasing interest in the use of small potatoes for seed purposes prompted a study on the effect of size of tuber and size of cut seed piece on the resulting potato yields. The experiment was con-

ducted at Aroostook Farm with three varieties of potatoes—Green Mountain, Katahdin, and Sebago. The lots of seed potatoes used were as nearly disease-free as could be obtained. The seed potatoes of each variety were carefully graded into the following size ranges: 1 to $1\frac{1}{4}$ inches, $1\frac{1}{4}$ to $1\frac{1}{2}$ inches, $1\frac{1}{2}$ to $1\frac{11}{16}$ inches, $1\frac{11}{16}$ to $1\frac{7}{8}$ inches, and $1\frac{7}{8}$ to $2\frac{1}{2}$ inches. The first four size ranges were planted whole and a portion of those ranging in size from $1\frac{11}{16}$ to $1\frac{7}{8}$ (large seconds) was split in two. From the $1\frac{7}{8}$ to $2\frac{1}{2}$ inch tubers seed pieces of two sizes, 1 ounce and $1\frac{1}{2}$ ounces, were cut. This resulted in four lots of whole seed and three lots of cut seed. Each lot of seed was planted with two rates of fertilizer on each of six plots. All lots of seed used were spaced exactly nine inches apart in the row and the rows were 36 inches apart.

Although the yields of the three varieties and the two rates of fertilizer were at somewhat different levels, the effect of size of seed piece used was similar in all cases. Table 46.

When whole tubers were planted the yield increased with size of tuber planted from 153 barrels per acre to 201 barrels per acre. When cut seed pieces were planted the yields increased with size of cut seed piece used from 164 to 191 barrels per acre. Whole tubers of a given weight produced somewhat higher yields than cut seed pieces of similar weight.

Plant and tuber counts indicated that tuber set increased somewhat with the size of seed piece planted. This was true for both whole and cut seed pieces. Grading data indicated a somewhat higher percentage of oversize tubers on the plots where small seed pieces were planted.

SEED SPACING AND VARIETY. Joseph A. Chucka, Arthur Hawkins, Bailey E. Brown. Eight of the more important varieties of potatoes have been compared relative to yielding ability when planted at six, nine, and twelve inches apart in the row. Florida tested seed stocks of very low disease content were secured for this test. The comparison was conducted at Presque Isle and at Stillwater over a three-year period. The 1941 plots at both locations were planted with seed saved from the 1940 Stillwater plots. New seed of Chipewewa and Green Mountain was secured for the 1942 test because of an increased leafroll content in the old stock. The other six varieties were replanted from the original seed stocks.

The yields secured as an average for the three years are presented in Table 47. At Presque Isle the rank of the varieties, in

terms of field-run tubers, in descending order was Earlane #2, Sebago, Chippewa, Houma, Green Mountain, Katahdin, Warba, and Irish Cobbler. In terms of U. S. No. 1 size the Green Mountain variety had a relatively higher rank while Houma had a lower rank.

At Stillwater the rank of the varieties, in terms of field-run tubers, in descending order was Earlane #2, Chippewa, Houma, Sebago, Katahdin, Irish Cobbler, Green Mountain, and Warba. In terms of U. S. No. 1 size such varieties as Sebago, Katahdin, and Green Mountain went up a little while Houma, Cobbler, and Chippewa dropped a little in relative rank.

All varieties tended to produce somewhat higher yields at the closer spacing. This was particularly true in terms of field-run tubers. In terms of U. S. No. 1 tubers most varieties produced highest or nearly highest yields at the nine-inch spacing. Grading data indicate that the six-inch spacing produces the smallest percentage of oversize tubers and a somewhat higher percentage of smaller tubers than either of the other two spacings.

From these data it appears that seed growers should use a close spacing, something like 6 or 7 inches. Such close spacing will result in somewhat higher total yields, fewer oversize potatoes, and better average seed size tubers. Table-stock growers should use a spacing of 9 to 10 inches. This spacing will reduce their seed requirements as compared to closer spacings and still produce approximately maximum yields of U. S. No. 1 size tubers. Wider spacings than 10 inches should be avoided when planting varieties that are subject to hollow heart. Katahdin, Cobbler, and Sequoia varieties are very subject to hollow heart during favorable growing seasons.

POTATO PRODUCTS

During the past year the greatest interest in potato products, in Maine, continued to be in potato starch but with increased interest in dehydrated potatoes. Some potato dextrin has been prepared in Maine and much has been made from Maine potato starch elsewhere, especially in Massachusetts and in New Jersey. Efforts are being made to make "amigel" from potato starch. "Amigel," a modified starch, is used as a molding starch and is now made from corn starch by chemical treatment and hot roll gelatinization.

POTATO STARCH PRODUCTION. Charles A. Brautlecht. Based on production capacity and other factors affecting production, it can be estimated that about 14,667 barrels capacity per day was in use on the 1943 Maine crop. Assuming an average of 180 working days operation, this represents about 2,640,000 barrels of eleven pecks, or 7,280,000 bushels of potatoes. The approximate starch content for the year, of potatoes going into starch factories, will be about 10 per cent or 43,800,000 pounds. With consideration of average operational efficiencies and the moisture present in the starch, as shipped, this represents about 44,000,000 pounds of starch. Forty-four million pounds of starch valued at 5.4 cents per pound, f.o.b Aroostook shipping point, is valued at about \$2,376,000. In addition, about 3,000,000 pounds of starch was made from southern potatoes owned by the Federal Government. With an increased production of potato starch in Idaho of about 15,000,000 pounds, there will be a record U. S. production of about 62,000,000 pounds, slightly larger than the 1941 production of about 60,000,000 pounds. The Maine production will probably be somewhat less than was made from the 1941 crop.

Quality of potatoes going into starch factories was inferior to that of previous crops, due, especially, to low starch content. Starch content of 33 samples of 1943 crop potatoes, to April 15, 1944, was as follows:

STARCH AND TOTAL SOLIDS

	STARCH PER CENT	TOTAL SOLIDS PER CENT
Average	10.3	19.5
Maximum	12.3 (Gr. Mt.)	21.6 (Gr. Mt.)
Minimum	7.8 (Sebagos)	17.4 (Sebagos)

There was a large decrease from previous years in starch content of starch factory potatoes from about 12.5 per cent as an average for past seasons, to about 10.5 per cent for the 1943 crop.

COMMERCIAL POTATO STARCH. Charles A. Brautlecht. Sixty samples of starch from the 1943 potato crop have been analyzed with the following results:

	AVERAGE	MAXIMUM	MINIMUM
Moisture, per cent	16.3	23.2	10.6
Total solids (by difference) %	83.7	89.4	76.8
Ash	0.28	0.47	0.10
Viscosity, centipoises			
for 1% soln. in 0.6% NaOH	4.7	9.7	2.0
Granule size, microns	28	52	21
Acid, quantity			
(cc. of 0.1 N NaOH per 25 g.)	4.4	6.8	0.7
Speck count, macro in 5 g. per			
sg. dcm.	662	2358	45
Sieve test (on powdered samples,			
finer than 200 mesh)	92.8	99.5	76.8
Bacteria (b. coli), 24 samples	12 positive 12 negative	5/5 in 0.01	
Reflectance (whiteness) %	88.5	97.5	72.3
pH (degree of acid)	6.3	7.5	6.0 (most acidic)
Solubles	0.21	0.64	0.06

Compared to starch from the 1942 crop of Maine potatoes, starch from the 1943 crop, including a few thousand cars of southern potatoes, was somewhat inferior. A few starch factories, however, maintained their high quality standards. Decrease in quality was due to (a) too many poor potatoes (b) insufficient supply of labor and poor quality of labor and (c) difficulty in obtaining replacement parts and getting repairs made.

POTATO DEHYDRATION. Charles A. Brautlecht. Forty-one samples of 1943 Maine crop potatoes from dehydration plants were examined with the following results:

	STARCH CONTENT PER CENT	TOTAL SOLIDS PER CENT
Average	12	19.8
Maximum	13.8 (Gr. Mt.)	21.9 (Gr. Mt.)
Minimum	8.8 (Sebagos)	16.0 (Sebagos)

Starch and total solids content fell off markedly for the 1943 crop as compared to the 1942 crop. Katahdins, Sebagos and Green Mountains were the varieties chiefly used with some Cobblers and some Chippewas. Since quality was inferior, in general, to that of the 1942 crop, picking table costs and picking table waste were much greater. There were excellent lots of all varieties and some

very poor lots of all of the common varieties. One lot of commercial Green Mountains, held over from 1942 under good storage conditions, was in excellent condition without sprouts and containing 27.5 per cent total solids. It was dehydrated with very good results in the laboratory late in August 1943. Net necrosis and stem-end browning were the chief difficulties encountered in many lots of Green Mountains going into dehydration plants. Hollow heart, sunburn, and low total solids with chilling injury occurred in many lots of Katahdins and sunburn, low total solids and chilling injury in many lots of Sebago.

Graying of potato pieces was found to be reduced, on a laboratory scale, by heating samples of potato pieces prepared without contact with any iron or steel, by heating in water for two minutes at 170° F. This graying apparently is associated with enzymes causing darkening of potatoes in contact with air for about one-half hour after peeling and varies with different lots of potatoes. It may be tyrosinase forming a trace of melanin or iron tyrosinate (as is met with in starch factories) from tyrosin, an amino acid present in the potato juice. Some potato juice, standing in air, also darkened. Another sample of cold pressed juice (Katahdin variety) yielded a slight qualitative test for iron.

In one series of tests Green Mountain potatoes with hollow heart were handled without any contact with iron. It was found that the sound flesh behaved normally. Pieces of potatoes with cavity edges had dark brown discoloration which was not eliminated by sulfonation with six parts per million of sulfurous acid in water at room or sub room temperatures. The sound flesh pieces, as dice, were placed in contact with iron rust in iron dishes and some in porcelain dishes and passed through a bronze wire belt blancher for four minutes at 210° F. and then dehydrated as usual. The edges blackened in the iron dishes whereas those not in contact with iron were not affected. This blackening was not appreciably influenced by immersion of potato pieces in dilute sulfite solution.

A recent trouble has been the darkening of dehydrated potatoes. Laboratory dehydrated potatoes, mostly Green Mountain variety, dehydrated with and without sulfiting showed that the sulfited pieces did not darken as readily as non-sulfited potatoes. Samples of commercial dehydrated potatoes prepared during the past three years, kept in tight or loose containers and in light or dark places, in some cases developed unpleasant odors or dark colors on

some pieces. Heat and air appeared to be factors causing such discoloration, at least in part. Laboratory prepared samples seemed more stable.

A series of commercial samples (strips) subjected to heat at 105° C. showed marked brown discoloration in a few minutes. This dark brown coloration increased with time of heating. Moisture decreased from 7.4 per cent in about 0.5 to 1.0 per cent increments to constant weight in 30 hours and underwent little change in an additional 20 hours. At 55° C. samples of the same lot darkened only very slightly in a period of 30 hours. Moisture loss in this period dropped very slightly from normal by slightly greater increments in 15 minute intervals in 49 hours from 7.4 per cent to about 3 per cent where it became constant at this temperature.

The question was asked if reducing sugars caused "graying" of dehydrated potatoes. An examination in a normal lot showed 1.46 per cent reducing sugars whereas the "grayed" lot showed 1.48 per cent, both computed as dextrose. Therefore graying was apparently not due to reducing sugars.

In a test of reducing sugar, or similar reducing substances, in good color and "browned" dehydrated potatoes, the good sample showed 1.2 per cent reducing sugar as dextrose and 2.8 per cent for the "browned" sample. Reducing sugars, or other reducing compounds, are thus apparently a factor in "browned" dehydrated potatoes.

Starch and Total Solids. Charles A. Brautlecht. Because of the difficulty encountered in dehydration plants, due to lower total solids, many samples of potatoes of the three principal Maine varieties which were dehydrated were examined for total solids and starch. There appeared no good correlation between starch and total solids content. The ratio of total solids to starch in experimental potatoes was about 1.6 to 1. In commercial potatoes, it varied for 44 samples collected between November 8 to April 18, from 2.06 to 1.54, there being a trend to the lower ratio for the latter part of the season.

One question raised by potato inspection officials was regarding the starch content of sunburned potatoes. Starch was extracted from one lot of sunburned Katahdins separated from a lot from a starch factory sample. The starch in the normal Katahdins was 11.2 per cent and in the sunburned potatoes was 10.3 per cent. This difference must be variable with the extent of sunburning. Pre-

vious tests on starch content indicated less starch in sunburned potatoes and this is in accord with impressions and convictions of many starch manufacturers. Otherwise than lower yield, sunburning does not seem to influence starch making.

TOTAL SOLIDS IN POTATOES. Charles A. Brautlecht. Using a procedure which yielded good checks, a large number of total solids determinations on common varieties of commercial Maine potatoes was made. These total solids determinations indicate or support a general opinion. This is that total solids of the same variety of potatoes varies widely with soil, cultivation, climatic conditions, fertilizer kind and quantity, and possibly many other factors. Experiments have shown that replacement of potassium chloride (muriate) by the same potassium oxide equivalent of potassium sulfate, other factors being equal, yields a better quality of potato with higher starch and total solids content.

ECONOMICS OF THE POTATO INDUSTRY

COSTS AND PRACTICES IN PRODUCING POTATOES IN SOUTHERN AROOSTOOK COUNTY. William E. Schrupf. The present report is concerned with information obtained on 172 farms in southern Aroostook County in 1942. The area represented includes Aroostook County towns south of Mars Hill.

The average size of farms was 171 acres including 84 acres of cropland and 58 acres of woodland. The remaining acreage was mostly pasture. The acres of potatoes per farm ranged from 6 to 140, the average being 25. Nine varieties of potatoes were represented, but the two varieties, Katahdin and Green Mountain, made up four-fifths of the potato acreage. The average yield rate of potatoes was 109 barrels per acre. Of the livestock, 72 per cent in terms of animal units were dairy animals. On the average, 7 dairy animals were kept per farm and all but 4 per cent of the farms had dairy animals. Twenty-two per cent of the farms were operated with two horses; 27 per cent with 2 horses, 1 general-purpose tractor, and 1 truck; and 6 per cent with 1 general-purpose tractor and 1 truck. The acres of potatoes in these groups of farms averaged 13, 32, and 32, respectively.

Seventeen per cent of the potatoes produced were sold from the field, 40 per cent were placed in track storage, and 43 per cent were

placed in farm storage. Loss in storage amounted to 12 per cent of the potatoes placed in storage. The average cost of growing and harvesting potatoes was \$1.04 per barrel. This cost does not include any of the farmers' cost of storing or selling. Seed potatoes planted averaged 7.5 barrels per acre. Of the total acreage, 65 per cent was planted with certified seed.

Fertilizer was applied at the average rate of 0.9 ton per acre. Although fertilizers of 22 different formulas were applied, the three formulas 5-8-10, 8-16-20, and 5-8-12 accounted for two-thirds of the potato acreage. Barnyard manure was applied to 21 per cent of the potato acreage at the average rate of 8.5 tons per acre. Green manure crops were applied to 9 per cent of the potato acreage. Crimson clover comprised 22 per cent of the total acreage of green manure. Potatoes were sprayed or dusted an average of 4 times. On 44 per cent of the potato acreage, Bordeaux mixture was applied as a wet spray; on 17 per cent other wet sprays were applied; and on 39 per cent copper-lime dust was applied.

On the average, 85 man hours, 50 horse hours, 6 tractor hours, and 9 truck hours were expended in producing an acre of potatoes. In general, the total cost of labor, power, and equipment in doing work on potatoes on the farms represented was less when tractors were used than when horses were used. For example, the cost of labor, power, and equipment in plowing with a tractor averaged \$3.44 per acre, and with 2 horses \$7.71 per acre, and in digging potatoes the cost when tractors were used averaged \$5.25 per acre and when horses were used \$6.53 per acre.

EFFECTS OF WARTIME CONDITIONS ON THE PRODUCTION OF POTATOES. William E. Schrupf. The information for this study was obtained in 1943 on 241 farms of which 197 were in Aroostook County and 44 in central Maine. Of the 197 farms in Aroostook County, 31 were in the northern part, 105 in the central, 38 in the southern, and 23 in the Ashland area.

Crop Acreages. The crop acreage increased an average of six acres per farm in Aroostook County and eleven acres per farm in central Maine from 1942 to 1943. These increases were due largely to the consolidation of farms and in part to the taking up of land that was formerly in pasture or woods.

Of the increase in crop acreage, 14 per cent was on farms of less than 24 acres of potatoes per farm, 37 per cent on farms of 24 to 49 acres, and 49 per cent on farms of 50 acres or over. Of the

increase in potato acreage, 14 per cent was on farms of less than 24 acres of potatoes, 29 per cent on farms of 24 to 49 acres of potatoes, and 57 per cent on farms of 50 or more acres of potatoes. Although the bulk of the acreage increase was on the larger farms, the percentage increase was largest on the small farms.

The increase in potato acreage in Aroostook County was accompanied by decreases in the acreages of grain, hay, and green manure crops and in central Maine by decreases in the acreages of grain, peas for canning, and green manure crops. In Aroostook County, the decreased crop acreage was made up by reductions of 57 per cent in grain, 27 per cent in hay, and 16 per cent in green manure crops. In central Maine, the decreased crop acreage consisted of reductions of 88 per cent in grain, 10 per cent in peas, and 2 per cent in green manure crops.

Potato Varieties. In Aroostook County, Katahdin and Green Mountain were the two chief varieties of potatoes, each comprising 30 per cent of the average potato acreage of the County for the two years 1942 and 1943. The other 40 per cent was made up largely of Irish Cobbler (14 per cent), Chippewa (13 per cent), Sebago (10 per cent), and Houma (2 per cent). In central Maine, the Katahdin variety made up 27 per cent of the potato acreage, Green Mountain 23 per cent, Sebago 16 per cent, Chippewa 15 per cent, Houma 11 per cent, and Cobbler 1 per cent. In contrast with the above, ten years ago the Green Mountain variety comprised about 85 per cent of the potato acreage in Maine, and Irish Cobbler most of the remaining acreage.

Livestock. From 1942 to 1943 the amount of livestock increased both on the farms in Aroostook County and in central Maine. In terms of animal units, the livestock increase in Aroostook County amounted to 12 per cent and in central Maine to 20 per cent. For Aroostook County as a whole, and for central Maine, the numbers of all classes of livestock increased, but on a percentage basis the largest increases were in beef animals, swine, and poultry. In 1943, animal units in Aroostook County averaged 10 per farm varying from an average of 8 per farm in the Ashland area to 12 per farm in southern Aroostook. On the central Maine farms, the average was 20 animal units per farm.

Labor. Seasonal help, including seed cutters, potato pickers, and other seasonal workers constituted slightly more than 75 per cent of the total farm labor. The remainder was made up of regular

help, members of the farm family and the operators themselves. Potato pickers comprised more than one-half of all the farm labor for the entire season. Of all the farm workers (including the farm operators), 72 per cent were male and 28 per cent female. Of the potato pickers, 65 per cent were male and 35 per cent female. Of all the workers, 50 per cent were 18 to 44 years of age and 23 per cent were 14 to 17 years of age. Workers less than 14 years of age made up 14 per cent of the total workers and those 45 or more years of age 12 per cent. Nearly 20 per cent of the potato pickers were less than 14 years of age.

Machinery. The age of horse-drawn machines on the farms in this study averaged 4 to 6 years older than similar tractor-drawn machines. For example, the average age of horse-drawn plows was 12 years, of tractor-drawn plows 5 years, of horse-drawn potato diggers 9 years, and tractor-drawn potato diggers 5 years. However, since the farmers indicated that the total years of use of tractor-drawn machines is 3 to 7 years less than that of horse-drawn machines, the difference in average age does not indicate that the tractor-drawn machines now on these farms may be expected on the average to last longer than the horse-drawn machines. As an illustration, the average time before the 12-year-old horse-drawn plow in the above instance is expected to need replacement is 5 years and for the 5-year-old tractor-drawn plow also 5 years.

Farmers indicated in 1943 that considerable replacement of machinery was desirable before another season. Desired replacements varied from 3 per cent of the tractor mowers to 27 per cent of the horse-drawn potato diggers. However, some of the indicated replacements were more imperative than others. Some of the machinery that would be replaced before another season if new machinery were available could be made to last another season if extensively repaired. For example, all of the 3 per cent of tractor mowers and 17 of the 27 per cent of the horse-drawn potato diggers could with extensive repairs be used another season. However, it was evident that the farm machinery was fast wearing out and that upward of 40 per cent of many types of machines now on these farms would be worn out in the next 3 years.

Extensive repairs were needed on a considerable number of most types of machines. As an illustration, of the horse-drawn machines 22 per cent of the plows, 29 per cent of the potato sprayers, and 35 per cent of the potato diggers, and of the tractor-drawn

machines 12 per cent of the plows, 15 per cent of the potato sprayers, and 19 per cent of the potato diggers were in need of extensive repairs.

POTATO STORAGE FACILITIES IN 1943. Charles H. Merchant. Maine farmers were encouraged to increase their potato acreage in 1943 by the establishment of government support prices and incentive payments to growers. Largely as a result of these assurances Maine farmers greatly increased their acreage of potatoes. The acreage was increased from 158 thousand acres in 1942 to 212 thousand acres in 1943. All commercial potato-producing areas in Maine showed a substantial increase in the acreage of potatoes planted.

Combined with this all-time record potato acreage for the State exceptionally high yield rates were expected. In fact, another all-time record was established at 355 bushels per acre. The previous record was 324 bushels per acre in 1934. Late in the summer it was recognized that major marketing problems were facing the potato industry in the State. These included the harvesting, storage and the utilization of the expected record potato crop. A study was immediately undertaken to ascertain the storage facilities available in each of the potato-producing areas of the State. Cooperation in this study was obtained from the Agricultural Adjustment Agency, railroads serving Maine, the Division of Agricultural Statistics of the Bureau of Agricultural Economics, State and Aroostook County War Boards, and growers and shippers of potatoes in Maine. The material assembled indicated that proper storage facilities were inadequate to house the enormous crop expected.

In September, 1943, it was estimated that there was storage for approximately 49 million bushels of potatoes. The crop forecasted as of September 1 by the Crop Reporting Service was indicated to be 62.4 million bushels. An unofficial estimate of the crop based on information obtained in this study was between 74 and 75 million bushels. The December crop report indicated the total production at 73.5 million bushels.

When the September Government crop estimate of 62.4 million bushels was used it was found that insufficient storage facilities existed in each of the potato-producing areas of the State, with the possible exception of the Island Falls area. However, the unofficial estimate of production indicated a lack of frost-proof storage in all

of the producing areas. Conditions as indicated after harvest showed a lack of storage facilities in all areas.

Potato growers with a small potato acreage in 1942 increased their plantings in 1943 about 45 per cent compared with 30 per cent for growers with large acreages. In general, the growers with small acreages had storage facilities for a smaller percentage of their crops than growers with larger acreages. The information obtained showed that growers with less than 20 acres of potatoes owned or had contracted storage for about 68 barrels of potatoes per acre, while growers with 80 or more acres of potatoes per farm owned or had contracted storage for about 112 barrels per acre. Stated in another way 70 per cent of the growers with less than 20 acres of potatoes lacked sufficient storage to house 100 barrels of potatoes per acre as compared with 44 per cent of the growers with 80 or more acres of potatoes per farm.

In general, it was found that about two-thirds of the growers would need additional storage facilities or would find it necessary to dispose of part of their potato crop before cold weather. This situation was serious both from the standpoint of adequate storage facilities and the transportation of large quantities of potatoes in the fall. Shipments of large quantities of potatoes which were necessary to avoid loss from freezing were difficult due to labor shortage, lack of railroad facilities and to a restricted market demand for potatoes during the early part of the marketing season.

This report helped in presenting the situation which encouraged immediate action on the part of State and Government officials in the storage and marketing of the 1943 potato crop.

Detailed information of this study was published in Maine Agricultural Experiment Station Miscellaneous Publication 577 under the title "Storage Facilities for the 1943 Maine Potato Crop."

RECENT PUBLICATIONS OF INTEREST TO POTATO GROWERS

BULLETINS

- No. 421. Rate of Spread and Effect on Yield of Potato Virus Diseases.
- No. 422. Incomes, Costs, and Practices on Three Types of Farms Producing Potatoes in Central Maine, 1938.
- No. 424. Costs and Practices in Producing Potatoes in Central Aroostook County, Maine, 1940.

- No. 427. Early Harvesting of Healthy Seed Potatoes for the Control of Potato Diseases in Maine.

MISCELLANEOUS PUBLICATIONS

- No. 577. Storage Facilities for the 1943 Maine Potato Crop.
No. 584. A Roguing Service for Producers of Foundation Seed Potatoes.
No. 588. Machinery Requirements on Aroostook County Farms.

ABSTRACTS OF ARTICLES PUBLISHED IN PERIODICALS

STUDIES ON THE MORPHOLOGY, PHYSIOLOGY, SEROLOGY, LONGEVITY, AND PATHOGENICITY OF *CORYNEBACTERIUM SEPEDONICUM*²²

A new medium is recommended for the isolation and cultivation of *Corynebacterium sepedonicum*. As nitrogen sources this medium contains Bacto peptone, Bacto tryptose, and Bacto yeast extract, and as carbon sources, dextrose, maltose, and occasionally lactose.

For the maintenance of stock cultures, liquid media are more suitable than agar media. Litmus milk is a splendid medium for identification and for the cultivation of stock cultures.

The best sources of carbon are monosaccharides such as arabinose, xylose, dextrose, galactose and levulose; rhamnose is not utilized. Disaccharides are utilized more slowly. Among other sources of carbon, mannitol is the best. All sources of carbon which are utilized are decomposed with a slow and sometimes only temporary increase of the acidity of the medium.

The new medium with the addition of sodium dichromate in concentration 1:20,000 can be used for the successful isolation of *C. sepedonicum* from potato tubers having symptoms of soft rot due to secondary infection with *Erwinia carotovora*.

Pure cultures of *C. sepedonicum* when added to sterile soil and left buried in the ground during the winter survived and retained their virulence.

Cultures of *C. sepedonicum*, if maintained on laboratory media, gradually lose their virulence towards potatoes. Infection experi-

²² This is an abstract of a paper by Stanislas F. Snieszko and Reiner Bonde having the same title and published in *Phytopathology*, Vol. 33, No. 11, pages 1032-1044. 1943.

ments in which macerated ring-rot tubers were stored for 13 days before inoculation gave negative results. Also, badly decayed tubers of ring-rot potatoes were not infectious.

C. sepedonicum is weakly antigenic for rabbits, producing agglutinating sera with low titre. All tested strains of *C. sepedonicum* were cross-agglutinated approximately up to the titre of all sera.

POTATO CULL PILES AS A SOURCE OF LATE-BLIGHT INFECTION²³

It is concluded that the cull pile is the chief source of primary late-blight infection in Maine and that the elimination of this source of infection would do much to prevent the early occurrence and spread of the disease in the fields. It appears very probable that the cull pile is a factor in the dissemination of the disease in other states as well. The possibility exists, however, that some late-blight infection may also come from the states located farther south and gradually be carried by the air currents from crop to crop northward into Maine and other potato-growing areas.

On most of the 6,000 potato farms in Aroostook County, Maine, as well as in the yards of many potato dealers there are one or more cull piles where waste potatoes are discarded each spring. The potato shoots growing from many of these cull piles become infected with late blight and serve as the primary sources of late-blight inoculum for commercial fields. A single infected cull pile may serve to infect all of the potatoes being grown in a locality. In one case, observed in 1942, late blight had spread to fields half a mile away in the direction of the prevailing winds.

The cull pile also is a place where the Colorado potato beetle and other insects multiply in great numbers. They migrate from here to nearby potato fields where they may cause much damage and add to the expense of growing the crop. Plants with leafroll, spindle tuber, and the mosaic diseases are found growing commonly in the cull piles, and aphids are generally present to serve as vectors of these virus diseases to the commercially grown potatoes in the vicinity. Eliminating the cull piles would not only help to control late blight but would also be a factor in the destruction of certain harmful potato insects. It also would be helpful in destroying a likely source of spread of potato virus diseases.

²³ This is an abstract of a paper by Reiner Bonde and Eugene S. Schultz having the same title and published in *The American Potato Journal*, Vol. 20, No. 5, pages 112-118. 1943.

APPENDIX

TABLE 1

Ring Rot Resulting from Treating Contaminated Potato Sacks with Different Disinfectants

Disinfectant ¹	Concentration of disinfectant	Ring rot developing from inoculating seed pieces with treated sacks
		Per cent ²
Copper sulfate	2 pounds in 10 gallons water	2
Formaldehyde	1 pint 40% in 15 gallons water	2
Formaldehyde	2 pints 40% in 15 gallons water	0
Chlorinated lime	Used as directed on containers	1
Calcium hypochlorite	Used as directed on containers	2
Lysol	1 - 100	0
Lysol	1 - 50	0
Corrosive sublimate	1 - 1000	0
Acidified corrosive sublimate	2 - 1000 plus 0.2% HCl	0
None	—	67

¹ Pieces of burlap potato sacks were severely contaminated with the ring rot organism taken directly from infected potatoes. The pieces of sack were soaked for 5-minute periods in the different disinfecting solutions before being used to contaminate freshly cut potato seed pieces.

² Based on disease readings from 100 inoculated seed pieces planted in the field.

TABLE 2

Comparison of Ring Rot Resistance in Different Commercial and Seedling Varieties—1943¹

Variety	Ring rot occurring
	Per cent of plants infected ²
Green Mountain	90.0
Houma	84.0
Katahdin	65.0
Sebago	35.0
President	0.0
S. 47102	0.0
S. 46952	3.0
S. 0.55	4.0

¹ The freshly cut surfaces of seed pieces were inoculated by being rubbed against ring-rot infected tuber material in the field.

² Percentages based on 10 replicated lots of 10 seed pieces each for the different varieties.

TABLE 3

Ring Rot Resistance in Different Progenies Inoculated under Field Conditions in 1943¹

Variety or Cross	No. seedlings tested ²	Percentage of resistant seedlings in progenies ³
Chippewa x 336-144	120	40.2
Houma x 336-144	57	40.5
96-56 x 336-144	100	45.9
96-345 x 336-144	80	39.6
336-144 selfed	43	75.0
President x 336-144	140	74.7
President x Earlane	353	38.2
President x Katahdin	141	48.9
Sebago x 46952	52	38.5
Earlaine x 46952	83	36.0
46952 x 336-144	92	54.0
46952 Selfed	25	61.0
Sebago x Earlane	97	20.0
Friso x Katahdin	120	48.6
Green Mountain Control	300	0.0 All infected

¹ Inoculations made in the field by rubbing the freshly cut seed pieces with ring-rot infected tuber material and then planting immediately.

² Two seed pieces inoculated for each seedling variety tested.

³ All seedlings which appeared to be free of ring rot as a result of being inoculated were dug and examined. The disease-free varieties were saved for further testing in 1944.

TABLE 4

Infection Resulting in Seedling Selections Inoculated with Ring Rot in Field Experiments in 1943¹ 2

Selection No.	Parentage	No. sets inoculated	Ring rot occurring
			Per cent of plants infected
1	Sebago x 336-144	70	0.0
2	Ditto	60	55.0
3	Ditto	80	21.3
	Green Mountain	50	100.0
4	Sebago x 336-144	50	32.4
5	Ditto	30	11.6
6	Ditto	50	20.8
7	Ditto	40	6.3
8	Ditto	30	11.7
	Green Mountain	50	80.0
9	Earlaine x 336-144	70	35.7
10	Ditto	70	25.0
11	Ditto	70	11.5
12	Ditto	40	7.5
	Green Mountain	50	100.0
13	Earlaine x 336-144	40	30.0
14	Ditto	40	23.7
15	Ditto	30	41.0
16	Ditto	30	15.3
	Green Mountain	50	100.0
17	Earlaine x 336-144	70	24.4
18	336-144 x Earlaine	40	13.0
19	Ditto	30	15.1
20	Ditto	40	37.5
	Green Mountain	50	100.0
21	336-144 x Earlaine	40	12.5
22	Ditto	60	20.2
23	Ditto	30	8.0
24	Ditto	30	22.5
	Green Mountain	50	98.0
25	336-144 x Earlaine	40	11.5
26	Ditto	50	5.0
27	41956 x 336-144	30	15.0
28	Houma x 336-144	50	10.0
29	Ditto	70	20.0
	Green Mountain	50	100.0

¹ Inoculations made in the field by rubbing the freshly cut seed pieces with ring-rot infected tuber material and then planting immediately.

² These seedlings were selected as being resistant to ring rot in tests conducted in 1942 and were tested again in 1943.

TABLE 5

Ring Rot Resulting from Inoculating Freshly Cut Seed Pieces with Pieces of Contaminated Potato Bags Stored at Different Temperatures

Storage condition	Inoculum used to contaminate bags ⁴	Percentage ring rot occurring ¹			
		After 103 days ²		After 200 days ³	
		Cut surfaces of seed pieces rubbed ⁵	Eyes seed pieces pricked ⁵	Cut surfaces of seed pieces rubbed ⁵	Eyes seed pieces pricked ⁵
Outside ⁶	Diseased tuber	40	50	0	30
	Pure culture	80	90	30	55
30° F. ⁷	Diseased tuber	65	55	15	10
	Pure culture	50	50	5	35
32° F. ⁷	Diseased tuber	60	75	0	5
	Pure culture	40	50	25	30
36° F. ⁷	Diseased tuber	20	45	5	5
	Pure culture	25	55	5	30
40-45° F. ⁸	Diseased tuber	25	45	0	0
	Pure culture	25	25	15	40
70° F. ⁷	Diseased tuber			0	0
	Pure culture			0	0
Control ⁹	Diseased tuber	80	55	70	90
	Pure culture	70	90	80	90

¹ Percentage based on 20 inoculated seed pieces for each test recorded.

² Pieces of sack contaminated November 2, 1942, and used to inoculate seed pieces February 13, 1943.

³ Pieces of sack contaminated November 2, 1942, and used to inoculate seed pieces May 21, 1943.

⁴ Pieces of burlap and cotton potato bags contaminated by being smeared with decay from tubers infected with ring rot.

⁵ Seed pieces inoculated (1) by freshly cut surfaces being rubbed with moistened contaminated bags, (2) by contaminated piece of bag being moistened with water and a drop of the water pricked into eyes.

⁶ Stored in box outside of Bonde garage at Orono.

⁷ Stored in controlled temperature bins at Aroostook Farm. Relative humidity 76 to 80 per cent.

⁸ Uncontrolled bin storage at Aroostook Farm.

⁹ Freshly contaminated pieces of sack used.

TABLE 6

Ring Rot Resulting from Inoculating Freshly Cut Seed Pieces with Pieces of Contaminated Potato Sacks Stored at Different Temperatures¹

Storage condition of pieces of sack	Percentage ring-rot plants resulting from inoculation ²			
	Burlap bags		Cotton bags	
	Seed pieces rubbed	Eyes pricked	Seed pieces rubbed	Eyes pricked
Outside ³	22	68	30	65
30° F. ⁴	100	96	90	94
32° F. ⁴	44	86	56	92
36° F. ⁴	72	94	42	58
40-45° F. ⁵	52	84	62	70
50° F. ⁴	58	78	50	84
70° F. ⁴	30	44	38	72
Control Fresh ring-rot material	50	52	60	60

¹ Potato sacks were cut into 12-inch square pieces and contaminated by being smeared with decay from infected tubers. They were placed at the different storage conditions February 18, 1943, and were used for inoculating the seed pieces June 12, 1943 (115 days).

² Percentages based on 50 inoculated seed pieces planted in the field.

³ Contaminated pieces of sack fastened to wall on north side of barn.

⁴ Controlled temperature chambers at Aroostook Farm, Presque Isle, Maine.

⁵ Unccontrolled bin storage at Aroostook Farm.

TABLE 7

*Stem-end Browning and Net Necrosis in Tubers from Permanent Plots
Aroostook Farm, Presque Isle, Maine—1943*

Plot No.	Fertilizer Treatment 2000# per acre unless otherwise stated	Per cent of 400 to 700 tuber samples	
		Net Necrosis	Stem-end Browning
Rate of Application			
317	No fertilizer	.4	.6
327	1500# 4-8-8	2.7	13.1
337	2000# 4-8-8	5.0	36.7
347	2500# 4-8-8	4.9	52.8
357	3000# 4-8-8	11.5	52.1
Fertilizer Ratios			
316	0-8-8	2.7	13.9
325	2-8-8	5.5	24.1
337	4-8-8	5.0	36.7
315	6-8-8	1.8	38.2
356	4-0-8	1.8	23.2
354	4-4-8	3.7	23.4
337	4-8-8	5.0	36.7
355	4-12-8	8.4	17.0
336	4-8-0	.3	0
345	4-8-4	6.2	3.7
337	4-8-8	5.0	36.7
346	4-8-10	8.7	48.2
344	4-8-12	3.4	58.6
314	4-0-8 (5 previous treatments were 4-8-8)	3.4	30.7
324	4-2-8	1.4	25.9
415	4-0-8 (8 previous treatments were 4-8-8)	3.5	27.7
405	4-2-8	2.9	40.2
416	4-8-8	4.7	37.8
Source of Nitrogen			
353	Nitrate of soda	4.4	24.4
343	Sulfate of ammonia	4.6	27.9
332	Urea	5.5	26.0
333	Fish meal	1.7	34.1
335	Cyanamid	6.0	13.1
337	% NO ₃ , % NH ₃ , ½ Org.	5.0	36.7
Chemically Pure Salts			
313	No Mg.	4.3	5.6
321		2.4	6.0
323	Plus B	3.7	9.7
331		1.9	7.6
341		3.0	11.7
342		2.6	4.3
352		5.3	14.0
Acid versus Neutral Fertilizers			
334	Acid mixture	2.7	25.2
351	Same plus Kieserite	5.3	31.8
322	Neutral with dolomite	5.1	23.8
326	Neutral with Ca limestone	3.1	22.5
Muriate versus Sulfate of Potash			
311 S	KCl	9.3	10.1
311 N	KCl limed	6.8	23.4
312 S	K ₂ SO ₄	1.7	6.4
312 N	K ₂ SO ₄ limed	4.6	8.5

TABLE 7—Concluded

Plot No.	Fertilizer Treatment 2000* per acre unless otherwise stated	Per cent of 400 to 700 tuber samples	
		Net Necrosis	Stem-end Browning
Effect of Organic Matter			
427	Crimson removed	6.2	12.4
426	Check	3.1	29.7
425	Check plus crimson from 427	9.8	23.5
424	Check plus straw (6 tons)	2.8	42.6
423	Check plus manure (20 tons)	14.3	37.7
Source of Nitrogen			
406	NaNO ₃	2.9	30.8
407 S ¹	(NH ₄) ₂ SO ₄	10.7	18.4
407 N ²	(NH ₄) ₂ SO ₄	6.6	18.7
417 S ¹	(NH ₄) ₂ SO ₄ {Lime in fertilizer	5.3	16.7
417 N ²	(NH ₄) ₂ SO ₄ }	4.7	17.8
Placement			
403	2500* 4-8-8 in row	14.2	30.3
413	500* 4-8-8 in row 2000 broadcast	5.7	35.0
404	500* 4-8-8 in row 2000 plowed under previous fall	3.2	33.1
414	2500* 1-8-10 in row with 100* N plowed under previous fall	1.7	24.2
Muriate versus Sulfate of Potash under Continuous Potatoes			
397	Check plus peat	7.2	22.8
396	Check	5.2	39.6
395	4-8-10	.8	26.2
394	2500 of 4-8-8	7.0	58.2
393	Check plus 20 tons manure	11.6	48.0
	Average of 5 KCl half plots	5.9	37.3
397	Check plus peat	.8	37.9
396	Check	8.7	42.5
395	4-8-10	2.7	20.9
394	2500 of 4-8-8	3.2	40.3
393	Check plus 20 tons manure	8.6	25.2
	Average of 5 K ₂ SO ₄ half plots	4.5	33.4

¹ South half of plots 407 and 417 unlimed.² North half of plots 407 and 417 limed.³ These plots received potash in the form of muriate from 1927 to 1941 inclusive. Beginning with 1942 muriate of potash was continued on half of each plot and sulfate of potash was substituted on the other half of each plot.

TABLE 8

Stem-end Browning and Net Necrosis in Tubers Produced with Fertilizers Containing Different Sources of Potash

Potash source in 5-8-12 applied at 2000 lbs. per acre	Tubers in sample examined	Per cent of Tuber Sample Showing				
		Net Necrosis	Stem-end Browning			
			Severe	Medium	Slight	Total
1. All potash from KCl	272	3.7	6.6	6.3	4.0	16.9
2. $\frac{1}{2}$ from KCl, $\frac{1}{2}$ from K_2SO_4	176	4.5	.6	5.1	2.8	8.5
3. $\frac{1}{4}$ from KCl, $\frac{3}{4}$ from K_2SO_4	272	1.1	5.9	11.0	3.3	20.2
4. All potash from K_2SO_4	271	.7	7.0	7.4	7.7	22.1
5. K metaphosphate and KNO_3	295	.7	5.8	8.5	3.1	17.4

TABLE 9

The Effect of Fertilizer Treatment on the Spread of Leafroll and on the Net Necrosis/Leafroll Ratio
Aroostook Farm Permanent Plots—3-year Rotation—
1942-43

1942 Treatment	1942 Net necrosis	1943 Leafroll	Net necrosis/Leafroll Ratio $\times 100$
	Per cent	Per cent	
No fertilizer	3	21.9	13.7
1500 lb.	12	26.9	44.6
2000 lb.	15	32.3	46.4
2500 lb.	22	42.3	52.0
3000 lb.	25	42.0	59.5
0-8-8	8	24.8	32.2
2-8-8	16	38.9	43.7
4-8-8	15	32.3	46.4
4-0-8	10	28.5	35.1
4-4-8	17	34.4	49.4
4-8-8	15	32.3	46.4
4-12-8	26	45.0	57.8
4-8-0	4	19.0	21.1
4-8-4	15	32.1	46.7
4-8-8	15	32.3	46.4
4-8-10	18	38.8	46.4
4-8-12	15	36.3	41.3
C.P. salts	4	22.8	17.5
C.P. salts	6	20.5	29.3
C.P. salts	4	20.7	19.3
K_2SO_4	8	24.1	33.2
KCl	15	27.8	54.0

TABLE 10

Effect of the Addition of Mercury Compounds to the Fertilizer

Compound	Rate per acre	Yield per acre ¹	SEB ²	NN ²
	lb.	bbl.	%	%
Mercuric chloride	5.74	104	33.2	16.7
Mercuric chloride	2.87	110	34.0	20.5
Calomel	5.00	128	15.6	14.6
Yellow mercuric oxide	4.57	107	27.8	21.8
Control		138	44.8	12.2
Minimum difference required for significance		22		

¹ Average of 5 rows, each 29 ft. long, in a Latin Square.² Stem-end Browning and Net Necrosis readings were obtained after tubers had been stored at 50° F. for 100 days or longer.

NOTE: SEB stands for stem-end browning, and NN stands for net-necrosis.

TABLE 11

Specific Gravity of Different Regions of Green Mountain Potato Tubers
Sections 1/10 in. x 3/4 in. were used

Region	Necrosis well developed		Necrosis slightly developed		No Necrosis
	SEB	NN	SEB	NN	CF
Stem-end 1 ¹	1.0216	1.0423	1.0460	1.0692	1.0712
Stem-end 2 ¹	1.0391	1.0573	1.0625	1.0795	1.0757
Center	1.0580	1.0604	1.0533	1.0663	1.0616
Bud-end	1.0678	1.0946	1.0861	1.0809	1.0902

¹ Region "Stem-end 1" refers to a section taken just below the stolon scar but including none of the corky scar tissue. "Stem-end 2" refers to the region immediately below the first section.

Note: CF stands for clear flesh.

TABLE 12

Spray Application of Borax Alone to Green Mountain Potatoes¹

Concentration of borax	No. applications	Borax applied per acre	Yield per acre	SEB ²	NN ²
		lb.	bbl.	%	%
0		0.0	138.4	19.4	9.0
0.1	1	1.9	147.9	18.7	11.1
	2	2.9	146.3	28.1	6.1
	4	5.4	139.2	18.5	4.8
	5	5.3	140.1	25.0	7.4
0.5	1	9.1	130.5	15.1	6.5
	2	11.1	111.8	20.8	3.8
	3	19.3	131.2	19.9	5.2
	4	24.8	122.7	20.5	10.3
	5	30.3	117.7	19.0	8.5
1.0	1	14.3	134.7	22.3	7.2
	2	21.5	117.6	30.7	9.4
2.0	1	31.4	127.4	19.8	6.4
	2	50.0	98.1	27.1	5.0

¹ This table is a summary of 5 plots. Since the controls (no borax) were about the same, the data were combined. Each figure is the average of 9 or more rows, each 29 ft. long.

² After storage at 50° F. for 100 days or longer.

TABLE 13

Effect of Application of Minor Elements to Green Mountains as a Spray

Compound	Concentration	No. of applications	Total amount applied per acre	Yield per acre ¹	NN ²	SEB ²
	%		lb.	bbl.	%	%
Zinc sulfate	1.0	3	33	117	14.2	52.8
Manganese sulfate	1.0	3	35	135	10.4	47.0
Potassium iodide	0.2	3	6	85	5.0	45.4
Sodium molybdate	0.2	3	5	138	21.6	43.9
Cadmium chloride	0.2	2	4	109	11.9	45.3
Strontium chloride	0.2	3	6	146	18.4	45.6
Chromium sulfate	0.2	3	6	129	6.9	55.1
Control				122	20.7	45.0
Minimum difference required for significance				21		

¹ Average of 6 rows, each 29 ft. long, in randomized blocks.

² Stem-end browning and net necrosis readings were made after the potatoes were stored at 50° F. for 100 days or longer.

TABLE 14

Net Necrosis in New Varieties with Leafroll Increase

Variety	Sample	Leafroll per cent 1942	Leafroll per cent increase 1942-1943	Net-necrosis per cent 1942-1943 at 51° F.	Ratio of NN per cent to leafroll per cent increase
Sebago	A	14±	43.6	8.4	0.19
	B	8.0	23.5	4.9	0.21
Katahdin		8±	5.0	0.5	0.11
Sequoia	A	0.2	33.9	1.3	0.04
	B	20±	13.4	0.7	0.05
Chippewa	A	18±	51.3	0.1	0.003
	B	20±	65.6	0.8	0.01

See Table 15 for similar figures for Irish Cobbler and Green Mountain.

TABLE 15

*Ratio of Net Necrosis to Leafroll Increase in Irish Cobbler and
Green Mountain Varieties*

Variety	Sample	Leafroll per cent 1942	Leafroll per cent increase 1942-1943	Net-necrosis per cent 1942-1943 at 51° F.	Ratio of NN per cent to leafroll per cent increase
Irish Cobbler	A	2.6±	53.5	10.1	0.19
	B	0.6	19.7	8.2	0.42
Green Mountain	A	5.0	21.7	4.3	0.20
	B	16.7	74.9	36.1	0.43
	C	1.0	6.8	4.1	0.60
	D	0.8	7.4	5.0	0.68
	E	8.5	14.9	15.3	1.03
	F	0.2	2.2	0.6	0.27
	G	3.2	15.9	5.2	0.33
	H	4.0	78.5	32.6	0.42
	I	3.2	18.2	9.6	0.53
	J	2.8	20.8	14.9	0.72
	K	0.3	13.1	11.7	0.89
	L	4.0	10.0	11.5	1.15
	M	7.0	46.6	35.7	0.77
	N	7.2	11.8	23.6	2.00
	O	0.2	0.5	0.6	1.20

TABLE 16

Net Necrosis and Stem-end Browning Development at Different Temperatures, during 120 Days

Field	Sample	Days at					Percentage	
		70°	65°	32°	36°	50°	NN	SEB
1	26	60	—	—	—	61	0	0.2
	34	30	30	—	—	61	0	8.6
	29	—	60	—	—	61	0	34.6
	7	—	—	121	—	—	0	0
	31	—	—	60	—	61	0	0
	36	—	—	—	60	61	0.3	0
	20	—	—	—	—	121	1.1	30.0
	26	60	—	—	—	61	0.6	0.1
	34	30	30	—	—	61	2.8	0
	29	—	60	—	—	61	7.8	5.5
3	7	—	—	121	—	—	0	0
	31	—	—	60	—	61	0.1	0
	36	—	—	—	60	61	3.5	0
	20	—	—	—	—	121	17.6	4.5
	26	60	—	—	—	60	3.4	0.3
	34	30	30	—	—	60	4.8	2.7
	29	—	60	—	—	60	10.2	3.5
	7	—	—	121	—	—	4.5	0
	31	—	—	60	—	60	3.2	0
	36	—	—	—	60	60	4.5	0
4	20	—	—	—	—	121	15.0	7.3
	26	60	—	—	—	60	3.4	0.3
	34	30	30	—	—	60	4.8	2.7
	29	—	60	—	—	60	10.2	3.5
	7	—	—	121	—	—	4.5	0
	31	—	—	60	—	60	3.2	0
	36	—	—	—	60	60	4.5	0
	20	—	—	—	—	121	15.0	7.3

TABLE 17

*Net Necrosis and Stem-end Browning Development in 60 Days at 50° F.
after Periods at Various Temperatures*

Field	Sample	Days at					Percentage	
		70°	65°	32°	36°	50°	NN	SEB
1	24	15	—	—	—	60	0.9	12.5
	25	30	—	—	—	61	0	13.2
	26	60	—	—	—	61	0	0.2
	33	15	15	—	—	61	0	12.9
	34	30	30	—	—	61	0	8.6
	27	—	15	—	—	60	0.6	33.0
	28	—	30	—	—	61	0.3	34.4
	29	—	60	—	—	61	0	34.6
	30	—	—	30	—	61	0	0
	31	—	—	60	—	61	0	0
	35	—	—	—	30	61	0	0
	36	—	—	—	60	61	0.3	0
	15	—	—	—	—	60	2.2	25.5
	18	—	—	—	—	91	2.3	30.7
	20	—	—	—	—	121	1.1	30.0
3	24	16	—	—	—	59	6.5	1.2
	25	30	—	—	—	59	1.8	0.4
	26	60	—	—	—	61	0.6	0.1
	33	16	14	—	—	59	2.3	0.3
	34	30	30	—	—	61	2.8	0
	27	—	16	—	—	59	13.8	3.1
	28	—	30	—	—	59	9.5	1.8
	29	—	60	—	—	61	7.8	5.5
	30	—	—	30	—	59	0	0
	31	—	—	60	—	61	0.1	0
	35	—	—	—	30	59	0	0
	36	—	—	—	60	61	3.5	0
	15	—	—	—	—	60	18.6	6.1
	18	—	—	—	—	89	22.7	2.4
	20	—	—	—	—	121	17.6	4.5
4	24	15	—	—	—	60	6.8	1.7
	25	30	—	—	—	62	10.2	0.1
	26	60	—	—	—	60	3.4	0.3
	33	15	15	—	—	62	7.1	0.3
	34	30	30	—	—	60	4.8	2.7
	27	—	15	—	—	60	13.7	8.2
	28	—	30	—	—	62	11.0	7.3
	29	—	60	—	—	60	10.2	8.5
	30	—	—	30	—	62	4.8	0
	31	—	—	60	—	60	3.2	0
	35	—	—	—	30	62	2.0	0
	36	—	—	—	60	60	4.5	0
	15	—	—	—	—	60	15.6	12.0
	18	—	—	—	—	92	17.0	6.0
	20	—	—	—	—	121	15.0	7.3

TABLE 18

Fading of Stem-end Browning and Net Necrosis Symptoms as Storage Period Lengthened—1942-1943

Series	Temp. °F.	SEB				NN			
		Peak		End of storage		Peak		End of storage	
		Days after digging	Per cent	Days after digging	Per cent	Days after digging	Per cent	Days after digging	Per cent
I	50	120	22	214	21	214	0.6	214	0.6
	36	91	1.7	214	0.6	None at any time			
II	50	122	42	208	37	122	1.7	208	0.1
	36	91	1.6	208	0.4	None at any time			
III	50	91	6	219	5	91	36	219	28
	36	91	1.5	219	1.2	91	20	219	11
IV	50	91	16	201	16	120	17	201	13
	36	91	0.4	201	0.4	201	1.6	201	1.6

TABLE 19

The Abundance of Fully Distended Aphid Eggs on Certain Parts of Several Plants. Surveys in Northeastern Maine. Fall of 1942 and Spring and Fall of 1943. Presque Isle, Maine, Laboratory

Location	Location number	Average number eggs per 100 buds or crotches		
		Fall 1942	Spring 1943	Fall 1943
<i>Prunus nigra</i> (wild plum) Buds				
Mt. Quaggy Joe, $\frac{4}{5}$ mi. S. Presque Isle	1	.4	.0	.0
Hayden thicket, 4 mi. S. Presque Isle on highway No. 1	2			.4
Sprague thicket, Spragueville, 4 mi. S. Presque Isle	3			2.8
Carmichael thicket, 1 mi. S. Presque Isle	4	.0	.0	2.2
Chase thicket, $\frac{1}{2}$ mi. S. Presque Isle	5			.0
Marks thicket, $\frac{1}{4}$ mi. S. Presque Isle	6			11.1
3.8 mi. W. Presque Isle, State road	7	.0	.0	.6
16.7 mi. W. Presque Isle, State road	8	.0	.0	.1
Hews thicket, 3 mi. E. Ashland, State road	9	.0	.0	.9
2.2 mi. S.W. Ashland, back road to Masardis	10	.0	.0	.0
Lannigan thicket, $5\frac{1}{2}$ mi. S.W. Ashland, back road	11	.2	.0	.2
Entrance to Oxbow on Highway 11	12			.0
0.7 mi. N. Sherman Station	13			.2
Boulter thicket, $\frac{1}{2}$ mi. W. Stacyville	14	.0	.0	.1
2.9 mi. E. Smyrna Mills, Highway No. 2	15	.0	.0	.8
2.2 mi. N. Houlton, Highway No. 1	16	.4	.11	.1
Hills Siding, approx. 10 mi. N. Houlton	17			1.4
Bridgewater	18			1.5
<i>Prunus pennsylvanica</i> (bird cherry) Buds				
	1	52.9	11.0	59.1
	7	12.7	4.6	45.0
	9	10.9	5.1	32.4
<i>Prunus virginiana</i> (chokecherry) Buds				
	12	abundant	7.04	19.2
	13		.0	2.5
	14		.0	.6
<i>Rhamnus alnifolia</i> (buckthorn) Buds				
Aroostook Farm	19	27.0	.44	32.4
Sherman Station	20			6.5
Snow Fence Shed, Stacyville	21	40.2	1.11	98.7
Estabrook Pasture, Stacyville	22	9.0	.36	9.7
1 mi. S. Bridgewater	18			5.5
1.2 mi. N. Mars Hill, Sandy Hunter's	23			36.7
<i>Rosa palustris</i> (Scotch rose) Crotches				
	4	6.4	3.0	2.6
	9			3.3
	10	.7	.4	3.7
	11	14.1	2.6	19.6
5.3 mi. N. Patten, Highway No. 11	24			.7
	14	.0	.0	7.8
Benedicta	25			3.0
	16			.0
Buds				
	4			16.7
	9			3.3
	10			2.6
	11			10.0
	24			6.6
	14			23.0
	25			17.4
	16			0.0
<i>Rosa rugosa</i> (an escaped rose) 6" of stem				
Hardy Hill, $\frac{1}{2}$ mi. E. Presque Isle	26			144.4
	9			233.3

TABLE 20

Leafroll Control Experiment—Estimated Yield¹ of Potatoes in Barrels at Six Farms Following Derris Dust Applications
Houlton, Maine—1943

Treatment	Estimated yield in barrels per acre at indicated farm						Average barrels per acre
	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	
Derris	173	190	190	184	151	185	175.5
Derris and Oil	161	177	210	160	166	178	175
Check	138	186	160	161	153	138	156

¹ Estimate based upon yield of 225 three-stalk plants taken at random in sets of 25, assuming a 36" space between rows, a 12" space in rows, and 80 per cent of a stand. Under this assumption the 225 plants equal 1/64.5 of an acre.

TABLE 21

Net Necrosis in Green Mountain Tubers from 1943 Experimental Plots at Houlton, Maine; Leafroll and Mosaic Appearing in Foliage after Tubers Were Planted in Florida¹

Farm	Treatment	Percentage of tubers showing net necrosis and of plants from tubers showing leafroll and mosaic		
		Net Necrosis	Leafroll	Mosaic
Farm 1	Derris without oil (early sample)	5	6	0
	Check (early sample)	4	3	0
	Derris with oil (late sample)	2	7	0
	Check (late sample)	4	9	0
Farm 2	Derris without oil (late sample)	2	12	2
	Check (late sample)	5	28	2
Farm 3	Derris with oil (early sample)	17	63	2
	Check (early sample)	46	98	0
	Derris with oil (late sample)	8	74	4
	Check (late sample)	7	97	2
Farm 4	Derris with oil (early sample)	2	46	19
	Derris with oil (late sample)	8	36	12
	Check (late sample)	18	67	6
Farm 5	Derris with oil (early sample)	6	13	6
	Derris with oil (late sample)	4	27	3
	Check (late sample)	3	18	5
Farm 6	Derris without oil (late sample)	2	17	5
	Check (late sample)	19	58	6
Averages	Derris (5 late samples)	4.33	28.83	4.33
	Check (5 late samples)	9.33	46.16	3.5
Averages for 1942 at six farms	Derris spray and dust plots	13.5	32.5	4
	Check plots	10	48	5

¹ Early samples were taken from plots the first part of September. Late samples were taken in October. All insecticidal treatments were in the form of dust mixtures.

TABLE 22
Summary of Number of Lots of Seed Tested in Florida—1941, 1942, and 1943

Variety	Number of lots tested			Number of lots not recommended for seed stock ¹			Number of lots recommended for growing						Percentage qualifying as foundation seed in 1943
	Table stock ²			Certified seed stock ³									
	1941	1942	1943	1941	1942	1943	1941	1942	1943	1941	1942	1943	
Bliss	7	4	4	2	2	0	3	2	1	2	0	3	46
Chippewa	83	57	142	7	29	20	16	15	53	10	13	66	
Earlane #2	1	1	0	0	0	—	0	1	—	1	0	—	
Green Mountain	129	94	137	20	12	11	60	35	46	49	47	80	60
Houma	31	10	1	0	0	0	2	3	0	29	7	1	
Irish Cobbler	77	89	120	11	19	3	30	42	42	36	28	75	62
Katahdin	71	83	109	4	1	0	7	15	8	60	67	101	92
Pontiac	1	1	0	0	0	—	0	0	—	1	1	—	
Russet	0	2	4	0	0	2	0	2	0	0	0	2	
Sebago	44	55	81	2	2	1	13	15	12	29	88	68	83
Sequoia	0	6	8	0	0	1	0	4	5	0	2	2	
Warba	2	1	1	0	0	0	2	1	1	0	0	0	
Mohawk	—	—	1	—	—	0	—	—	—	—	—	1	
MS-100	0	0	1	—	—	0	—	—	0	—	—	1	

¹ More than 10 per cent leafroll.

² Not more than 10 per cent leafroll.

³ Not over 2 per cent total virus.

TABLE 23
Summary of Acreage by Varieties in the 1941, 1942, and 1943 Florida Test Expressed on a Percentage Basis

Variety	Acreage entered			Not recommended for planting ¹ Percentage			Recommended as table stock seeds ² Percentage			Recommended for planting for certification ³ Percentage		
	1941	1942	1943	1941	1942	1943	1941	1942	1943	1941	1942	1943
Bliss	78.0	43.0	38.0	11	26	None	63	74	48	23	None	52
Chippewa	484.8	796.5	1646.7	40	67	23	43	21	43	17	12	34
Earline #2	4.4	12.0	0	None	None	None	None	All	None	All	None	None
Green Mountain	2008.6	1578	1914.6	18	10	9	43	54	46	36	36	45
Houma	136.0	98.5	24.0	None	None	None	10	66	None	90	44	All
Irish Cobbler	1230.9	1510.8	1915.5	9	25	6	47	53	30	44	19	64
Katahdin	763.5	1009.4	1465	None	3	None	17	14	11	83	83	89
Pontiac	1.0	9.0	0	None	None	None	None	None	None	All	All	None
Russet	0	16.0	18.5	None	None	91	None	All	None	None	None	9
Sebago	274.3	513.1	692.0	1	7	1	37	35	15	62	58	84
Sequoia	0	22.5	63.6	None	None	20	None	89	63	None	11	17
Warba	12.0	6.0	8.0	None	None	All	All	All	All	None	None	None
Mesaba	0	0	1.5	None	None	None	None	None	None	None	None	All
Mohawk	0	0	0.5	None	None	None	None	None	None	None	None	All

¹ More than 10 per cent leafroll.

² Not more than 10 per cent leafroll.

³ Not more than 2 per cent total virus.

TABLE 24
Summary of Acreage by Varieties Represented in Florida Test—1941, 1942, and 1943

Variety	Acreage represented			Not recommended for planting ¹			Recommended as table stock seed ²			Recommended for planting for certification ³		
	1941	1942	1943	1941	1942	1943	1941	1942	1943	1941	1942	1943
Bliss	78.0	43.0	38.0	8.5	11.0	0	51.5	32.0	18.0	18.0	0	20.0
Chippewa	484.8	793.5	1646.7	191.0	530.4	381.5	209.3	169.6	710.4	84.5	96.5	554.8
Earlaine #2	4.4	12.0	0	0	0	0	0	12.0	0	4.4	0	—
Green Mountain	2008.6	1578.0	1914.6	358.9	163.5	181.4	932.0	851.5	887.2	717.7	563.0	846.0
Houma	136.0	68.5	24.0	0	0	0	13.5	38.5	0	122.5	30.0	94.0
Irish Cobbler	1230.9	1510.8	1915.5	116.6	382.5	17.0	592.5	840.5	797.0	531.8	287.8	1111.5
Katahdin	763.5	1009.4	1465.0	0	28.0	0	132.5	137.7	163.3	631.0	843.7	1303.7
Pontiac	1.0	9.0	0	0	0	0	0	0	0	1.0	9.0	0
Russet	0	16.0	18.5	0	0	17.0	0	16.0	0	0	0	1.5
Sebago	274.3	513.1	692.0	3.3	32.0	7.0	100.0	183.5	111.0	171.0	297.6	574.9
Sequoia	0	22.5	63.6	0	0	13.0	0	20.0	40.6	0	2.5	10.0
Warba	12.0	6.0	8.0	0	0	0	12.0	6.0	8.0	0	0	0
Mesaba	0	0	1.5	0	0	0	0	0	0	0	0	1.5
Mohawk	0	0	0.5	0	0	0	0	0	0	0	0	0.5

¹ More than 10 per cent leafroll.

² Not more than 10 per cent leafroll.

³ Not more than 2 per cent total virus.

TABLE 25

Effect of Growth Substances on Green Mountain Potatoes

Growth substance	Concentration	Soaked 12 hours ¹			Soaked 1 hour ¹		
		Yield per acre	SEB ²	NN ²	Yield per acre	SEB ²	NN ²
		bbl.	%	%	bbl.	%	%
None		120	9.5	3.2	137	10.7	6.8
Indole acetic acid	0.01%	122	13.0	12.9	159	9.4	3.2
Transplantone ³	1 oz./10 gal.	148	7.5	7.9	134	13.1	8.4
Indole butyric	0.01%	76	18.0	7.3	127	10.7	11.8
Naphthalene acetic acid	0.01%	110	14.3	9.4	134	10.7	13.7
Minimum difference required for significance		17			19		

¹ All figures in these columns are the averages of 5 rows, each 29 ft. long in a Latin Square.

² After storage at 50° F. for 90 days or longer.

³ Supplied by American Chemical Paint Co., Ambler, Pa.

TABLE 26

Stem-end Browning in Green Mountains Grown in Sand and Fed by Continuous Flow Method. Greenhouse, Fall 1943

Levels of potassium ppm	Levels of boron ppm	Percentages ¹ of Stem-end Browning at levels of calcium—ppm			
		50	200	500	All
50	3	33.3	12.5	41.7	25.8
	0.3	9.1	7.1	5.0	6.7
	0.01	7.1	5.6	0.0	4.0
	All	10.5	8.3	12.5	10.5
200	3	5.3	0.0	6.3	3.7
	0.3	13.5	13.3	23.0	16.0
	0.01	16.7	40.0	46.2	28.6
	All	12.3	10.2	23.8	15.1
500	3	23.5	27.0	30.0	26.3
	0.3	28.9	8.3	14.3	22.7
	0.01	41.7	7.1	33.3	27.3
	All	34.1	13.5	28.6	25.0
All	3	15.4	10.8	23.7	16.3
	0.3	21.6	9.7	12.7	15.1
	0.01	20.0	10.8	25.5	20.3
	All	19.0	10.5	20.4	16.9

¹ All percentages are weighted averages. Tubers stored at 50° F. for over 90 days.

TABLE 27

Yield Comparison of Green Mountain Plots Sprayed with Bordeaux Mixture Prepared with Different Formulae and Applied with Tractor-Power Machine—1943

Formula ¹	Total copper sulfate used for season.	Yield per acre ² ³	
		Barrels	Bushels
10-10-100	91.0	201.3±2.81	552.7± 7.40
10- 5-100	91.0	191.8±3.67	526.8±10.35
8- 4-100	72.8	203.2±3.29	557.8± 9.29
6- 3-100	54.6	194.5±2.66	534.2± 7.16
4- 2-100	36.4	199.2±3.76	546.9±10.56

¹ Plots received 7 applications of approximately 135 gallons per application, using a tractor-drawn spray outfit.

² Yields based on mean of 12 one-row replicated plots, each 100 feet long.

³ Significance at the 5 per cent level is 13.15 barrels or 36.0 bushels per acre at the 5 per cent level.

TABLE 28

Summary Yields—Barrels and Bushels Per Acre for Green Mountains Sprayed with Different Copper Fungicides at Three Different Concentrations¹

Fungicide	Formulae used in terms of Bordeaux Mixture					
	6-3-100		8-4-100		10-5-100	
	Barrels	Bushels	Barrels	Bushels	Barrels	Bushels
Bordeaux	196.1±2.17	538.5± 6.11	194.5±1.63	534.2±4.76	193.8±2.26	531.4±6.68
Spray-cop ²	184.8±2.35	507.5± 6.92	182.8±1.49	502.1±4.08	184.6±2.58	507.7±7.09
Basi-cop ³	183.9±3.89	505.3±10.52	179.1±2.23	492.9±6.12	186.6±3.04	511.6±8.30
Cuprocide ⁴	186.5±3.09	512.3± 8.36	189.5±1.35	520.4±3.43	189.1±3.14	520.0±8.63
Copper Hydro Arsenate, etc. ⁵	180.4±1.89	495.3± 4.76	181.3±1.25	498.3±3.54	170.4±2.59	467.3±6.82

¹ This experiment was conducted on four separate fields and, therefore, the yields for the different concentrations cannot be compared directly with each other.

² Said to contain 34 per cent metallic copper.

³ Said to contain 52 per cent metallic copper.

⁴ Said to contain 83 per cent metallic copper.

⁵ Said to contain approximately 17.97 per cent metallic copper and 10.99 per cent arsenic. Applied at rate of 3, 4, and 12 pounds respectively in 100 gallons.

TABLE 29

Summary Yields—Bushels and Barrels Per Acre for Katahdins and Green Mountains Sprayed with Different Fungicides

Fungicide	Yield per acre ¹			
	Katahdin		Green Mountain	
	Bushels	Barrels	Bushels	Barrels
Bordeaux	483.7±6.55	176.6±2.30	533.5±6.21	194.0±2.26
Basi-cop ²	486.1±6.58	159.2±2.37	514.5±8.41	187.1±3.06
Copper Hydro Arsenate, etc. ³	451.0±3.19	164.6±0.99	452.7±7.12	171.4±2.59

¹ Yields based on 18 replicated one-row plots, each 200 feet long.

² Manufactured by Sherwin-Williams Co., Cleveland, O., and said to contain 52 per cent metallic copper.

³ Manufactured by Chipman Chemical Co., Bound Brook, N. J., and said to contain approximately 17.97 per cent metallic copper and 10.59 per cent arsenic.

TABLE 30

Effect on Yield and on the Amount of Stem-end Browning and Net Necrosis of Adding Borax to the Fungicidal Spray Mixture

Fungicide	Amount of borax in spray solution ¹	Yield per acre ²		Net Necrosis	Stem-end Browning
		Barrels	Bushels	Per cent	Per cent
Bordeaux	None	197.5±4.19	543.1±11.45	8.9	13.0
Bordeaux	1 pound in 100 gallons	195.0±2.59	536.3± 6.93	15.4	19.3
Bordeaux	3 pounds in 100 gallons	197.1±4.39	542.0±11.96	7.0	14.3
Bordeaux	6 pounds in 100 gallons	186.6±3.25	513.2± 8.79	9.6	19.9
Basic copper sulfate	None	193.6±3.51	532.4± 9.61	6.0	29.9
Basic copper sulfate	3 pounds in 100 gallons	192.9±2.91	530.5± 8.18	9.6	29.9

¹ Borax was dissolved in hot water and added to the spray mixture just prior to applying the spray.

² Each yield is average of eight replicated one-row plots each 75 feet long. Significance at 5 per cent level is 15.51 barrels or 42.77 bushels.

TABLE 31

Yield Comparison of Two Organic Spray Materials with Bordeaux and Copper Oxychloride for Sebago Variety—1943

Fungicide	Formula used	Yield rate per acre	
		Barrels	Bushels
Bordeaux control	10-5-100	158.1±3.79	434.5±10.26
Fermate ¹	2-100	153.6±4.67	421.9±12.64
He 175 ²	2-100	152.1±3.25	417.9± 8.60
Compound A ³	5.5-100	158.1±3.32	434.0± 8.90

¹ Supplied by E. I. du Pont de Nemours and Co., Inc. Active ingredient is Ferric Dimethyldithiocarbamate.

² Disodium ethylene bisdithiocarbamate manufactured by Röhm and Haas Co., Philadelphia, Pa.

³ Supplied by E. I. du Pont de Nemours and Co., Inc. Technically tetra copper calcium oxychloride.

TABLE 32

*Late Blight Rot Developing in Potatoes Held at Different Temperatures
Samples Were from a Commercial Field, 1943 Crop*

Sample	Days at temperature of					Total	Per cent of tubers late blight at end of storage period
	70° F.	65° F.	32° F.	36° F.	50° F.		
111					22	22	8.8
112					31	31	13.1
113					40	40	22.6
114					50	50	18.0
115					60	60	19.7
116					70	70	20.4
117					80	80	20.6
118					91	91	18.0
119					100	100	19.1
120					121	121	18.0
121					161	161	17.6
122					200	200	20.7
123					239	239	19.9
124	15				60	75	22.1
125	30				61	91	24.6
126	60				61	121	23.7
127		15			60	75	25.4
128		30			61	91	19.8
129		60			61	121	20.5
130			30		61	91	2.1
131			60		61	121	4.7
132	60				31	91	37.3
133	15	15			61	91	20.5
134	30	30			61	121	22.1
135				30	61	91	2.3
136				60	61	121	4.1

TABLE 33

Summary of Weekly Aphid Counts—Variety Series

Variety	Date of Count					
	July 24 ¹	July 29	Aug. 5 ²	Aug. 13	Aug. 20	Aug. 26
Susceptible:						
Katahdin	102	107	214	480	1427	Dead
Sebago	89	257	151	321	892	Dead
Green Mountain	137	342	270	692	751	Dead
McKeller Seedling	52	156	96	131	258	Dead
<i>Solanum caldasi</i>						
glabrosum	208	542	258	660	882	293
USDA #41956	114	229	76	308	656	449
Mohawk	92	225	130	248	434	684
Pontiac	137	263	161	343	346	525
Pawnee	63	248	80	367	384	212
Tolerant:						
Golden	52	132	70	184	616	535
Columbia Russet	77	170	68	166	457	366
Cobbler	54	114	75	127	400	460
Chippewa	50	64	98	152	362	372
Dakota Red	65	73	47	131	334	319
Shamrock	23	42	38	71	324	333
Blue Christie	86	125	59	132	304	305
Sequoia	51	74	22	80	218	329
President	20	79	31	51	103	491
Mesaba	107	202	117	217	210	184
Netted Gem	28	61	24	50	191	195
Bliss Triumph	27	50	28	28	68	307
Resistant:						
Parhasia	36	77	29	21	40	59
Houma	32	23	39	17	14	264
Burbank	31	25	17	11	113	168
Immune:						
<i>Solanum polyadenium</i>	3	1	0	3	0	0

¹ Counts of July 24 and 29 were made of the absolute populations.² Counts of August 5 to 26 were made by sampling population on 9 leaflets at 3 levels of the plant.

TABLE 34

Summary of Weekly Aphid Counts—Diseased Series

Disease	Variety	Date of count and numbers of aphids					
		July 29 ¹	Aug. 5 ²	Aug. 16	Aug. 20	Aug. 23	Sept. 2
Rugose Mosaic	Gr. Mt.	105	9	268	496	510	152 vines dead
Mild Mosaic	Gr. Mt.	120	29	113	198	303	105 vines dead
Leafrolling Mosaic	Gr. Mt.	126	25	332	178	223	84
Net Necrosis	Gr. Mt.	25	30	246	241	713	280
Chronic Leafroll	Gr. Mt.	81	47	117	195	367	134
Latent Free	Katahdin	130	74	798	932	627	vines dead
Spindle Tuber	Katahdin	179	124	269	347	617	258
Leafroll	Katahdin	107	30	124	252	45	9
Latent Free	Chippewa	47	10	183	241	283	vines dead
Leafroll	Chippewa	122	26	103	505	691	94
Latent Free	Sebago	107	30	161	254	632	vines dead
Latent Free	Mobawk	88	5	84	92	220	143
Virus "Y"	42898	68	36	125	183	169	50
Virus "A"	41956	145	43	297	396	494	135
							99 vines dead

¹ Count of July 29 made of absolute population.² Counts of August 5 to September 2 were made by sampling populations on 9 leaflets at 3 levels of the plant.

TABLE 35

Mahogany Browning in Chippewas Kept at Low Temperatures

	Sample	Days at		Total days	Per cent Mahogany browning
		32° F.	36° F.		
Field 6 ¹	1	62		62	0
	2	90		90	3.1
	3	121		121	36.4
	4	150		150	97.0
	5	180		180	91.5
	6	213		213	93.1
	7	238		238	93.7
	8	60	178	238	5.5
	9	90	148	238	53.5
	10	120	118	238	95.1
	11	150	88	238	93.9
	13	213	25	238	88.7
Field 5 ¹	1	60		60	42.6 ²
	2	90		90	57.1
	3	120		120	69.1
	4	151		151	97.9
	5	180		180	94.2
	6	221		221	95.2
	8	60	180	240	85.1
	9	90	150	240	94.6
	10	120	120	240	90.5
	11	151	90	241	100.0
	12	180	60	240	88.2
	13	210	30	240	95.7

¹ Field 6 was on Aroostook Farm and supposedly had sufficient leafroll to aggravate mahogany browning. Field 5 was on a nearby farm where there was no leafroll. However, there was considerable rot in the potatoes from this field necessitating a discard of from 50 to 84 per cent of the tubers from the various samples.

² Excluding 53 to 95 per cent rotten, in series from field 5.

TABLE 36

Effect of Purple Top on Yield Rate in the Katahdin and Sebago Varieties—1943

Variety	Kind of seed tubers	Kind of plants produced				Yield per acre ¹		Loss or increase	Odds
		Normal	Slightly dwarfed	Very dwarfed	No plants missing hills				
		%	%	%	%	Barrels	Bushels	Barrels	
Katahdin	Healthy hills (controls)	100	0	0	0	188± 6.1	517±16.8	—	—
	Purple Top hills (Hard tubers) ²	12	17	44	27	82± 6.9	226±19.0	-106	M to 1
	Purple Top hills (Soft tubers) ²	0	25	13	62	56±14.0	154± 5.1	-132	M to 1
Sebago	Healthy hills (controls)	80	20	0	0	158± 5.8	435±16.0	—	—
	Purple Top hills 1st year removed (Hard tubers) ²	44	42	14	0	144± 6.6	396±18.2	-14	7.92
	Purple Top hills 1st year removed (Soft tubers) ²	26	40	27	7	72± 5.4	198±14.7	-86	10.94
	Purple Top hills 2nd year removed	90	8	2	0	212± 5.5	583±14.9	+54	6.73

¹ Based on 15 replicated 4-hill plots for each yield rate given.² Hills having purple top were harvested in 1942 for planting in 1943. The wilted or soft tubers from each hill were separated from those that were firm and normal in appearance. These were planted separately in 1943.

TABLE 37

The Effect of Purple Top on the Amount of Tuber Wilting Produced in Katahdin Potatoes and the Plant Symptoms Resulting by Planting Seed Tubers Having Different Degrees of Wilting

Condition of seed tubers	Tubers in each class ²	Tubers with ¹ abnormal sprouts ³	Plants produced by seed stock			
			Normal	Slightly dwarfed	Very dwarfed	None (missing hills)
	%	%	%	%	%	%
Firm	44	70	43	3	17	37
Slightly wilted	20	76	50	3	6	41
Badly wilted	36	81	3	0	16	81
Control tubers	—	0	95	5	0	0

¹ Tubers with different degrees of firmness were planted separately and the plant symptoms that developed were recorded.² Tubers from purple top plants in the Katahdin variety were harvested and separated into three classes according to the degree of wilting.³ Mostly "hair sprouts" or failed to germinate.

TABLE 38

Percentage of Tubers with Abnormal Sprouts and the Effect on Stand in the Field from Planting Seed Tubers Harvested from the Healthy and Diseased Parts of Purple Top Plants

Variety	Part of plant ²	Tubers with ¹ abnormal sprouts ³	Plants resulting from seed planted			
			Normal	Slightly dwarfed	Very dwarfed	No plants (missing hills)
		%	%	%	%	%
Katahdin	Healthy stalks from diseased plants	80.0	50.0	8.3	19.5	22.2
	Diseased stalks	82.0	23.6	2.6	36.8	37.0
	Healthy controls	0.0	98.0	2.0	0.0	0.0
Sebago	Healthy stalks from diseased plants	50.0	66.0	27.2	0.0	6.8
	Diseased stalks	72.0	23.2	50.0	13.0	8.8
	Healthy controls	0.0	91.0	9.0	0.0	0.0

¹ The tubers were planted in the field and observations made on the plants produced by the different lots of seed tubers.

² Tubers from the healthy and diseased parts of the same plant were harvested separately.

³ Either weak sprouts known as "hair sprouts" or failure to emerge and produce plants.

TABLE 39

Recovery in Katahdin and Sebago Seed Stocks Infected with Purple Top in 1941

Source of seed stock	Number of tubers planted	Symptoms produced	
		Sprouts	Plants
Purple Top Katahdin plant selected 1941	20	Normal	Normal
Small plant 1942			
"	7	Normal	Normal
"	22	Normal	Normal
"	5	Normal	Normal
"	4	Normal	Normal
"	7	Normal	Normal
Purple Top Katahdin plant selected 1941	10	Normal	Normal
No plant produced 1942			
Small tubers on mother tuber used as seed			
"	8	Normal	Normal
Purple Top Sebago plant selected 1941	20	Normal	Normal
Small plant 1942	40	Normal	Normal

TABLE 40

Early Harvesting as a Means of Controlling Leafroll. Foundation Seed Plots. 1942-1943

Variety	Number of plots early harvested		Number of plots late harvested		Average per cent of leafroll in plots early harvested		Average per cent of leafroll in plots late harvested	
	1942	1943	1942	1943	1942	1943	1942	1943
Bliss	0	1	0	0	—	0	—	—
Chippewa	6	11	2	2	0.35	0.14	7.1	0.8
Green Mountain	7	14	14	11	0.1	0.08	1.2	0.9
Irish Cobbler	6	10	7	5	0.23	0.1	1.07	0.4
Sebago	8	8	12	9	0.07	0.12	0.77	0.5
Katahdin	8	7	7	10	0.18	0.04	0.32	0.5
Houma	3	0	4	0	0.0	—	0.9	—

TABLE 41

Foundation Seed Plot Acreage by Varieties Qualifying as Foundation Seed—1943-1944

Variety	Acreage qualifying as foundation seed ¹		Number of lots qualifying	
	1942	1943	1942	1943
Bliss Triumph	None entered	2	None entered	1
Chippewa	13.7	24.4	8	10
Sebago	49.5	43.4	19	17
Katahdin	31.2	40.75	15	16
Green Mountain	45.1	71	16	20
Irish Cobbler	21.5	38	12	15
Houma	7.3	None entered	7	None entered
Sequoia	1	0	1	0

¹ 2 per cent or less total virus.

TABLE 42

Borax in Potato Fertilizers—1943. Green Mountains Grown on Caribou Loam. Planted May 29 and Harvested September 29

Band placement per acre rate	Yield per acre			
	Bushels	Barrels	Effect of added borax	
			Bushels	Barrels
1. 1334 lbs. 6-9-15—No borax	545	198	—	—
2. Plus 5 lbs. borax	539	196	-6	-2
3. Plus 15 lbs. borax	487	177	-58	-21
4. Plus 25 lbs. borax	483	176	-62	-23
Difference required for significance by Analysis of Variance	(22)	(8)	(22)	(8)

12 plots (single 50-ft. row) of each treatment randomized arrangement in the area. Fertilizer machine placed.

TABLE 43

Fertilizer Placement Test with Green Mountain Potatoes—1943
Planted at Aroostook Farm on Caribou Loam May 29 and
Harvested September 25

Treatment	Acre Yields	
	Bushels	Barrels
1. 2000 lbs. 6-6-12 in row (Standard method)	473	172
2. 1500 lbs. in row and 500 lbs. on plow sole	487	177
3. 1000 lbs. in row and 1000 lbs. on plow sole	483	176
4. 500 lbs. in row and 1500 lbs. on plow sole	527	192
5. None in row and 2000 lbs. on plow sole	465	169
6. 2000 lbs. applied broadcast before plowing	535	194
7. 2000 lbs. applied broadcast after plowing	498	181
8. 1000 lbs. 4-12-4 in row and 1000 lbs. 8-0-20 on plow sole	476	173
Difference necessary for significance at Fisher's 5 per cent point	59.4	21.6

6-6-12 fertilizer used in all but treatment No. 8. Test was conducted on land which was in potatoes in 1942. Duplicate plots were used each 18 feet x 75 feet.

TABLE 44

Effect of Fertilizers Varying in Salt Index and Concentration on Potato Yields at Two Rates of Application

Treatment	Acre yield			
	Distance between fertilizer band and seed piece		Average	
	1"	2"		
	Bushels	Bushels	Bushels	Barrels
1. 2500* 4-6-10 Low salt index	502	514	508	185
2. 2500* 4-6-10 High salt index	491	492	492	179
3. 3750* 4-6-10 Low salt index	470	501	486	177
4. 3750* 4-6-10 High salt index	457	443	450	164
5. 1250* 8-12-20 Low salt index	522	484	503	183
6. 1250* 8-12-20 High salt index	507	520	514	187
7. 1875* 8-12-20 Low salt index	475	480	478	174
8. 1875* 8-12-20 High salt index	484	500	492	179
Difference required for significance			32	11

Yield data based on averages of ten 50-foot rows per treatment.

Soil type: Caribou loam Variety: Green Mountain Location: Presque Isle, Maine

TABLE 45
*Mineral Nutrient Content in Pounds per Acre in Potatoes of Different Varieties*¹

Variety	Yield per acre		Mineral nutrients per acre of plants (tubers removed) and tubers per acre											
			Nitrogen (N)			Phosphoric Acid (P ₂ O ₅)			Potash (K ₂ O)			Calcium Oxide (CaO)		
	Bu.	Bbl.	Plts.	Tu.	Tot.	Plts.	Tu.	Tot.	Plts.	Tu.	Tot.	Plts.	Tu.	Tot.
Chippewa	605	220	48	120	167	5	32	37	79	200	279	54	4	58
Cobbler	594	205	65	108	174	8	33	41	181	208	388	56	4	60
Gr. Mt. ²	474	172	59	77	136	8	21	29	194	165	353	41	3	44
Katahdin	595	216	71	115	186	9	29	37	170	210	380	39	3	42
Sebago ²	392	143	71	74	145	9	21	30	166	148	314	57	3	60
												22	12	34
												17	15	32
												21	11	32
												26	13	39
												25	8	33

¹ At date of sampling September 1, 1943.

² Yields of the late varieties, Green Mountain and Sebago, increased appreciably after date of sampling.

TABLE 46

*Potato Yields as Affected by Size of Whole and Cut Seed Piece
Planted—Maine—1943*

Size of tuber used as seed Diameter in inches		Average weight of seed piece in ounces	Acre yield in barrels
1 to 1¼	whole	.61	153
1¼ to 1½	whole	.88	177
1½ to 1 11/16	whole	1.31	185
1 11/16 to 1¾	whole	1.77	201
1 11/16 to 1¾	split	.86	164
1¾ to 2¼	cut	1.03	174
1¾ to 2¼	cut	1.46	191
Difference required for significance			10.6

The data are an average of three varieties (Green Mountain, Katahdin, and Sebago) and two rates of fertilizer application.

TABLE 47

*Seed Spacing and Potato Variety Test. Average Yields for the Years 1940,
1941, and 1942*

Variety	Acre Yield in Barrels							
	U. S. No. 1 size				Field Run			
	Six- inch spacing	Nine- inch spacing	Twelve- inch spacing	Av.	Six- inch spacing	Nine- inch spacing	Twelve- inch spacing	Av.
At Presque Isle, Maine								
Chippewa	121	128	128	126	150	148	143	147
Cobbler	94	105	103	101	129	134	125	129
Earlaine #2	129	140	146	138	162	166	164	164
Green Mountain	127	129	129	128	146	142	140	143
Houma	116	114	118	116	153	143	143	146
Katahdin	123	123	119	123	150	142	136	143
Sebago	128	133	126	129	151	151	143	148
Warba	122	118	113	118	151	138	129	139
	120	124	123		149	146	140	
At Stillwater, Maine								
Chippewa	106	100	95	100	138	125	113	125
Cobbler	82	83	83	84	119	114	104	112
Earlaine #2	114	113	109	112	145	137	127	136
Green Mountain	94	94	86	91	120	113	100	111
Houma	98	94	86	92	136	123	109	124
Katahdin	101	97	91	96	127	114	105	115
Sebago	105	104	102	104	132	120	115	122
Warba	79	79	73	77	108	102	91	100
	97	96	91		128	118	108	

